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(71) Applicants: **ARCELORMITTAL** [LU/LU]; 24-26, Boulevard d'Avranches, L-1160 Luxembourg (LU). **LUXEMBOURG INSTITUTE OF SCIENCE AND TECHNOLOGY (LIST)** [LU/LU]; 41, rue du Brill, 4422 Luxembourg (LU).

(72) Inventors: **URIOS, Thomas**; 25, rue Lamartine, 57330 Hettange-Grande (FR). **CHOQUET, Patrick**; 40, rue Robert Schuman, 57050 Longeville Les Metz (FR). **ERSHOV, Sergey**; Hossegaass, 11, 5687 Dalheim (LU).

(74) Agent: **PLAISANT, Sophie**; ArcelorMittal France, Research & Development, Intellectual Property, 6 rue André Campra, 93200 Saint-Denis (FR).

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(54) Title: A COATED STEEL SUBSTRATE, A METHOD FOR THE MANUFACTURE OF A COATED STEEL SUBSTRATE, A METHOD FOR MANUFACTURE OF A STEEL PRODUCT AND A STEEL PRODUCT

(57) Abstract: The present invention relates to a coated steel substrate coated with a first coating comprising chromium and a second coating comprising from 2 to 30wt.% of Aluminum, from 10 to 40wt% of chromium, the balance being iron, said steel substrate comprising Cr ≤2.0% by weight; a method for the manufacture of this coated steel substrate; a method for the manufacture of a coated hot steel product; a coated hot steel product and the use of a hot steel product.

A coated steel substrate, a method for the manufacture of a coated steel substrate, a method for manufacture of a steel product and a steel product

The present invention relates to a coated steel substrate, a method for the manufacture of this coated steel substrate, a steel product and a method for the manufacture of this steel product. The invention is particularly well suited for the industry, civil engineering and construction fields.

In industry, civil engineering and construction fields, steel products are often used as metallic parts, in particular for marine metallic structures. For example, the metallic parts can be steel pilings, bearing piles, plates and beams used in the construction of combined walls, moles, parts of offshore wind powers or offshore structures. The main problem of these steel products is their resistance to corrosion. Indeed, the steel products are used in corrosive areas, i.e. in sea area. Due to these corrosive areas, the lifetime of such steel products can be divided by 5 when compared to the use of such steel products on earth. Thus, there is a need to provide metallic substrates having a higher resistance to corrosion in order to improve their lifetime especially in corrosive atmospheres.

Some protections can be used to protect these steel products. For example, it is known to produce these steel products with a sacrificial thickness, the lifetime depending on the thickness of the steel product. However, even if the sacrificial thicknesses improve the lifetime of these steel products, they do not really improve the corrosion resistance. It is also know to deposit paints or metallic coatings such as a zinc coating by hot-dip galvanizing. However, these deposition processes are very expensive and difficult to implement at industrial scale especially for long and heavy products.

Indeed, for example for the hot-dip galvanizing process, usually, a coil is firstly annealed and then hot-dipped in a zinc bath in the hot-dip galvanizing line. With the actual lines, it is difficult to cover long products such as beams or pilings.

Indeed, for example, the steel pilings are produced by hot-rolling at about 1250°C. The semi-finished products called “beam blank” pass through walking beam furnace. Then, the scale formed during the reheating are removed from the beam blank. The blanks pass through rolling mills. After, the length of the steel

piling is about 100m. The steel piling is then cut in order to obtain a final length of around 20m. The steel piling is finally cooled down and can be implementing in the soil in the sea. Due to the length and the shape of the steel piling, it cannot be hot-dipped in continuous hot-dip galvanizing lines.

Moreover, during the reheating step, semi-finished products oxidized in a form of scale. Scale is usually formed all around the semis surface. Thus, a large amount of scale is removed during the descaling step resulting in a weight loss of the steel product.

The patent application JPH0413862 discloses a coated steel material coated with a Cr or Cr alloy-plating layer having a thickness ≥ 0.1µm and an Al or Al alloy-plating layer having a thickness ≥ 0.1µm. This coated steel material is heat-treated at a temperature above 500 and up to 650 °C for a short time in an in-line continuous heating furnace. Mutual diffusion is produced between Al and Cr plating layers by the heat treatment allowing a good heat and corrosion resistances. The formation of an Fe-Al intermetallic compound at the steel/coating interface is inhibited decreasing cracks during deformation.

However, the temperature range of the heating is very low. Theses coatings cannot be used for a steel substrate which must stay in a reheating furnace at a high temperature. Indeed, it is mentioned in this patent application that above 650°C, the diffusion between Cr and Al layers is too important. So, they diffuse even to the steel sheet and Al will form a Fe-Al system intermetallic compound which will causes cracks during processing and cause a degradation of heat and corrosion resistance.

The patent application JPH02236272 discloses a coated steel material coated with Cr or an alloy of Cr including Ni or Co having a thickness ≥ 0.1µm and further, an Al layer or an alloy layer of Al including Cr, Ti, Ni, Co, etc., such alloy layer having a thickness ≥ 0.1µm. The steel product having two layers consisting of the Cr system and the Al system is heat-treated at 200 to 500°C in a nonoxidative atmosphere. Mutual diffusion arises between Cr layer and Al layer by this heat treatment. The formation of an Fe-Al intermetallic compound at the steel/coating interface is inhibited. The generation of cracks in the vapor deposited layer of the Cr system at the time of working is prevented by the diffused layers

and the corrosion based on cracks decreases. The steel product coated with the two layers has heat resistance generated by the Cr and good appearance generated by the Al.

However, the heat is performed in a non-oxidative atmosphere to prevent the oxidation of aluminum and chromium. A non-oxidative atmosphere is difficult to implement in a reheating furnace on line. Indeed, usually, the atmosphere of a reheating furnace comprises air. Moreover, the temperature range of the heating is very low. Theses coatings cannot be used for a steel substrate in a reheating furnace. Indeed, it is mentioned in this patent application that above 500°C, the diffusion will arise not only between Cr and Al layers, but also with iron from steel sheet. This leads to the formation of a Fe-Al system intermetallic compound which will causes cracks during processing and cause a degradation of heat and corrosion resistance.

Thus, the object of the invention is to provide a coated steel substrate wherein the weight loss due to the oxidation of semi-products during the reheating step before the rolling is reduced. The object is also to provide a steel product having an improved resistance to corrosion, and therefore a longer life time especially in corrosive environment.

This object is achieved by providing a coated steel substrate according to anyone of claims 1 to 14.

Another object is achieved by providing a method for the manufacture of a coated steel substrate according to anyone of claims 15 to 19.

Another object is achieved by providing a method for the manufacture of a steel product according to claim 20 to 22.

This object is achieved by providing a steel product according to anyone of claims 23 to 28.

Finally, the object is achieved by providing the use of a steel product according to claim 29.

To illustrate the invention, various embodiments and trials of non-limiting examples will be described, particularly with reference to the following Figure:

Figure 1 illustrates an example of coated steel substrate according to the present invention.

Figure 2 illustrates another example of coated steel substrate according to the present invention.

Figure 3 illustrates an example of a steel product after reheating according to the present invention.

Other characteristics and advantages of the invention will become apparent from the following detailed description of the invention.

The following terms will be defined:

- “wt.%” means the percentage by weight.

As illustrated in Figure 1, the invention relates to a coated steel substrate coated with a first coating comprising above 40wt.% of chromium and a second coating comprising from 2 to 30wt.% of Aluminum, from 10 to 40wt% of chromium, the balance being iron, said steel substrate comprising Cr ≤ 2.0% by weight.

Without willing to be bound by any theory, it seems that when the steel substrate is coated with a first coating consisting of chromium and a second coating comprising from 2 to 30wt.% of Aluminum, from 10 to 40wt% of chromium, the balance being iron, the steel substrate is well protected during the reheating since the first and the second coatings act together to significantly limit the oxidation reducing therefore the scale formation during the reheating of the coated steel substrate. Moreover, they also allow chromium to diffuse in steel increasing the corrosion resistance of steel and therefore, the lifetime of steel substrate.

Preferably, the steel substrate has the following chemical composition in weight percent:

$C \leq 2.0\%$,

$Al \leq 2.0\%$,

and on a purely optional basis, one or more elements such as

$Mn \leq 2.5\%$,

$Si \leq 2.5\%$,

$P < 0.1\%$,

$Nb \leq 0.5\ \%$,

$B \leq 0.005\%$,

$S \leq 0.02\%$,

$N \leq 0.1\%$,

Mo ≤ 0.50%,

Ni ≤ 1.0%,

Ti ≤ 0.5%,

the reminder of the composition making up of iron and inevitable impurities resulting from the elaboration.

Indeed, without willing to be bound by any theory, it is believed that the amounts of Al and Cr in the steel are preferably below 2.0wt.% because if the amounts of Al and Cr in the steel is above 2.0wt%, there is a risk to reduce the diffusion of Cr in steel.

Preferably, the steel substrate comprises an aluminum amount being equal or below 1.0wt% and more preferably, being equal or below 0.5wt%. Indeed, without willing to be bound by any theory, it is believed that an enrichment of aluminum in the steel substrate can be provided mainly with the second coating. It is believed that the enrichment of aluminum allows for an improvement of the oxidation resistance.

Preferably, the steel substrate comprises a chromium amount being equal or below 1.0wt% and more preferably, being equal or below 0.5wt%. Indeed, without willing by any theory, it is believed that an enrichment of chromium in the steel substrate is provided mainly with the first coating. It is believed that the enrichment of chromium allows for an improvement of the corrosion resistance.

Advantageously, the first coating consists of chromium meaning that the amount of chromium is ≥ 99wt.%.

Preferably, the first coating has a thickness between 0.5µm and 1000µm, more preferably between 0.5 µm and 500µm, advantageously between 1.0 µm and 200µm. Indeed, without willing to be bound by any theory, it is believed that if the thickness of the first coating is above 1000µm, there is a risk that the diffusion of chromium into steel is too important leading to a modification of mechanical properties of steel.

As illustrated in Figure 2, advantageously, the first coating comprises at least two layers 21, 22 comprising chromium. In this case, many layers of chromium are deposited forming one first coating consisting of chromium.

Preferably, the second coating comprises at least two layers comprising from 2 to 30wt.% of Aluminum, from 10 to 40wt% of chromium the balance being iron. Figure 2 represents an example wherein the second layer comprises three layers 31, 32 and 33 comprising from 2 to 30wt.% of Aluminum, from 10 to 40wt% of chromium the balance being iron.

When at least two layers of the first coating and/or second coating are deposited, it is believed that they are in a form of tortuous path. Thus, it seems that the oxygen diffusion through the coating is very restricted allowing an important reduction of the scale formation and a significant weight gain of the steel substrate.

Preferably, the second coating comprises from 15 to 30 wt.% of chromium.

Advantageously, the second coating comprises from 8 to 20 wt.% of aluminum.

Preferably, the second coating has a thickness between 0.5µm and 1000µm, more preferably between 0.5 µm and 500µm, advantageously between 1.0 µm and 200µm. Indeed, without willing to be bound by any theory, it is believed that when the thickness of the second coating is above 1000µm, there is a risk to decrease to barrier effect of the coating and therefore to increase the oxygen absorption during the reheating furnace.

Preferably, the thickness of the first coating is less than the thickness of the second coating.

Preferably, the first and/or second coating further comprises at least one additional element chosen from among: yttrium, silicon, calcium, titanium, zirconium, vanadium, niobium and nickel. It seems that these elements further improve the adhesion of the oxides formed on the coating surface during the reheating. Preferably, the amount of at least one element is below 10wt%, more preferably 8wt.%, advantageously 4wt.% and for example below 2wt.% or below 1wt.%. Advantageously, Thus, the amount of at least one element is above 0.1wt.%. It is believed that the steel is well protected against oxygen and therefore oxidation.

Advantageously, the substrate is a semi-finished product such as a beam blank, slab, billet or bloom.

Another object of the present invention relates to a method for the manufacture of a coated steel substrate according to the present invention comprising the following step:

A. The provision of a steel substrate according to the present invention,
B. The deposition of the first coating according to the present invention,
C. The deposition of the second coating according to the present invention,
D. Optionally, a preparation step on the steel surface performed before step B) and/or C).

Preferably, the deposition of the first and second coating independently from each other is performed by Physical Vapor Deposition (PVD), cold spray, chemical vapor deposition (CVD), hot-dip coating or electrodeposition.

Optionally, a preparation step is performed in step D). It is believed that this step provides a discontinuous microstructure on the steel substrate and/or on the first coating delaying the oxygen diffusion into the steel substrate.

Preferably, in step D), the preparation step is performed using physic bombardment of the steel surface including ions, electrons, metallic cluster, light, an energetic plasma or using chemical treatment such as pickling.

Preferably, in steps B) and/or C), when the first and/or the second coating(s) comprise(s) at least two layers, steps B) and/or C) are performed for each layer.

Preferably, when the first and/or the second coating(s) comprise(s) at least two layers, step D) is performed before the deposition of each layer.

Another object of the present invention relates to a method for manufacture of a steel product comprising the following successive steps:

I. The provision of the coated steel substrate according to the present invention,
II. The reheating of the coated steel substrate in a reheating furnace having an atmosphere containing oxygen with a temperature between 850 and 1400°C,
III. Optionally, the descaling of the reheated coated steel obtained in step II) and

IV. Optionally, the hot-forming of the descaled steel product.

The reheating step II) is performed at a temperature between 850 and 1400°C, preferably between 1200 and 1400°C. As illustrated in Figure 3, it is believed that after the heating, the steel substrate 31 is coated with an alloyed coating layer 32 comprising aluminum, chromium, the balance being iron directly topped by an oxide layer 33 comprising at least aluminum oxide, the alloyed coating layer and steel being alloyed through diffusion. This oxide layer acts like a barrier to oxygen decreasing the formation of scale. The oxide layer can further comprise chromium and/or iron oxide. Advantageously, the oxide layer comprises at least one oxide selected from: Al_2O_3, Cr_2O_3, $FeAl_2O_4$ and $FeCr_2O_4$. Moreover, it seems that this oxide layer allows chromium 34 to diffuse into the steel substrate increasing thus the corrosion resistance of the steel.

Optionally, during step III), the descaling is performed using water under pressure or the descaling is performed mechanically. Preferably, the water pressure is between 100 and 150 bars. It is believed that when the descaling is performed, the alloyed coating and the oxide layer are removed.

Preferably, in step IV), the hot forming is a hot-rolling, hot extrusion, hot stamping or hot bending.

Preferably, in step II), the atmosphere is an air atmosphere.

With the method according to the present invention, a steel product is obtained, said steel product comprising a decreasing chromium gradient starting from the steel product surface. Optionally, said steel product can be coated with an alloyed coating layer comprising aluminum, chromium, the balance being iron directly topped by an oxide layer comprising at least aluminum oxide, the alloyed coating layer and steel being alloyed through diffusion.

Preferably, the steel product comprises:

- a first region starting from the steel product surface comprising above 5.0wt.% of chromium and
- a second region starting from the first region comprising below 5.0wt% of chromium.

Preferably, the steel product comprises below 15wt.% of chromium in the first region extending from the steel surface.

Preferably, the steel product is hot formed. For example, the steel product is hot rolled, hot extruded, hot stamped or hot bended

Preferably, the steel product is chosen from: a piling, a wire, a rod, a plate, a tube, a rail, a corner, profile and a beam.

Preferably, the steel product is chosen from: a piling, a wire, a plate, a tube and a beam.

Finally, the object of the present invention relates to the use of a steel product according to the present invention, for the manufacture of offshore structure, offshore wind power, marine current power, hull of a boat, coastal and port infrastructure, quay wall , underground structure, rail and anchorage.

Examples

For all samples, the steel substrate has the following composition in weight percent (wt.%):

C	Cr	Al	Si	Mn	S	P
0.16	0.02	0.03	0.18	1.18	0.004	0.01

All samples were firstly casted in the form of beam blanks.

For Trial2, steel substrate was coated with one layer of FeAl(12wt.%)Cr(24wt.%) by magnetron sputtering.

For Trials 3 to 9, 11 and 12, steel substrates were coated with a first coating consisting of chromium having a thickness of 2µm and a second coating comprising Al(12wt.%), Cr(24wt.%) and optionally yttrium(0.3 wt.%), the balance being iron, having a thickness of 8µm. For the second coating, 4 layers of 2µm were deposited by magnetron sputtering. For some Trials, an ion bombardment step was performed before each deposition of layer.

Then, uncoated steels (Trials 1 and 10) and coated steels (Trials 2 to 9, 11 and 12) were reheated at a temperature being between 1000 and 1250°C. When a dynamic heating was performed, the heating temperature varied from 350 to 1250°C, the temperature being above 1000°C during 1h30. After the reheating, the oxidation of the Trial was determined by visual aspect: 3 means that the mill

scale was present on the whole Trial; 2 means that mill scale is mainly present on the Trial; 1 means that mill scale is present on a little part of the Trial and 0 means that mill scale is not present at all on the Trial. When the mill scale was on the whole Trial, the thickness of the mill scale was measured by Scanning Electron Microscopy (SEM). Results are shown in the following Table 1:

Trials	Coating		Reheating step		Mill scale (µm)	Visual aspect
	Coating	Etching	temperature (°C)	time		
1	-	no	1150	2h	770-1160	3
2	FeAlCr	no	1150	2h	450µm	3
3*	1st coating: Cr 2nd coating: FeAlCr	no	1200	30min	-	0
4*	1st coating: Cr 2nd coating: FeAlCr	yes	1200	30min	-	0
5*	1st coating: Cr 2nd coating: FeAlCr	no	1250	30min	-	0
6*	1st coating: Cr 2nd coating: FeAlCr	yes	1250	30min	-	0
7*	1st coating: Cr 2nd coating: FeAlCrY	yes	1250	30min	-	0
8*	1st coating: Cr 2nd coating: FeAlCr	yes	1250	1h	-	2
9*	1st coating: Cr 2nd coating: FeAlCrY	yes	1250	1h	-	1
10	-	no	1250	dynamic heating 2h	620-1150	3
11*	1st coating: Cr 2nd coating: FeAlCr	yes	1250	dynamic heating 2h	-	2
12*	1st coating: Cr 2nd coating: FeAlCrY	yes	1250	dynamic heating 2h	-	0

*: according to the present invention

Trials according to the present invention showed excellent results compared to comparative Examples.

Claims

1. A coated steel substrate coated with a first coating comprising above 40wt.% of chromium and a second coating comprising from 2 to 30wt.% of Aluminum, from 10 to 40wt.% of chromium, the balance being iron, said steel substrate comprising Cr ≤ 2.0% by weight.

2. A coated steel substrate according to claim 1, wherein the steel substrate has the following chemical composition in weight percent:

C ≤ 2.0%,

Al ≤ 2.0%,

and on a purely optional basis, one or more elements such as

Mn ≤ 2.5%,

Si ≤ 2.5%,

P < 0.1%,

Nb ≤ 0.5 %,

B ≤ 0.005%,

S ≤ 0.02%,

N ≤ 0.1%,

Mo ≤ 0.50%,

Ni ≤ 1.0%,

Ti ≤ 0.5%,

the remainder of the composition making up of iron and inevitable impurities resulting from the elaboration.

3. A coated steel substrate according to claim 2, wherein the steel substrate comprises an aluminum amount being equal or below 1.0wt%.

4. A coated steel substrate according to anyone of claims 1 to 3, wherein the steel substrate comprises a chromium amount being equal or below 1.0wt%.

5. A coated steel substrate according to anyone of claims 1 to 4, wherein the first coating consists of chromium.

6. A coated steel substrate according to anyone of claims 1 to 5, wherein the first coating has a thickness between 0.5µm and 1000µm.

7. A coated steel substrate according to anyone of claims 1 to 6, wherein the first coating comprises at least two layers comprising chromium.

8. A coated steel substrate according to anyone of claims 1 to 7, wherein the second coating comprises from 15 to 30 wt.% of chromium.

9. A coated steel substrate according to anyone of claims 1 to 8, wherein the second coating comprises from 8 to 20 wt.% of aluminum.

10. A coated steel substrate according to anyone of claims 1 to 9, wherein the second coating has a thickness between 0.5 µm and 1000µm.

11. A coated steel substrate according to anyone of claims 1 to 10, wherein the thickness of the first coating is less than the thickness of the second coating.

12. A coated steel substrate according to anyone of claims 1 to 11, wherein the second coating comprises at least two layers comprising from 2 to 30wt.% of Aluminum, from 10 to 40wt% of chromium the balance being iron.

13. A coated steel substrate according to anyone of claims 1 to 12, wherein the first and/or second coatings further comprise at least one element chosen from among: yttrium, silicon, calcium, titanium, zirconium, vanadium, niobium and nickel.

14. A coated steel substrate according to anyone of claims 1 to 13, wherein the substrate is a semi-finished product such as a beam blank, slab, billet or bloom.

15. A method for the manufacture of a coated steel substrate according to anyone of claims 1 to 14 comprising the following step:
    A. The provision of a steel substrate according to anyone of claims 1 to 4,
    B. The deposition of the first coating according to anyone of claims 5 to 7 and 13,
    C. The deposition of the second coating according to anyone of claims 8 to 13,
    D. Optionally, a preparation step on the steel surface performed before step B) and/or C).

16. A method according to claim 15, wherein the deposition of the first and second coating independently from each other is performed by Physical Vapor Deposition (PVD), cold spray, chemical vapor deposition (CVD), hot-dip coating, electro-deposition.

17. A method according to claim 15 or 16, wherein in step D), the preparation step is performed using physic bombardment of the steel surface including ions, electrons, metallic cluster, light, an energetic plasma or using chemical treatment such as pickling

18. A method according to anyone of claims 15 to 17, wherein in steps B) and/or C), when the first and/or the second coating(s) comprise(s) at least two layers, steps B) and/or C) are performed for each layer.

19. A method according to anyone of claims 15 to 18, wherein when the first and/or the second coating(s) comprise(s) at least two layers, step D) is performed before the deposition of each layer.

20. A method for manufacture of a steel product comprising the following successive steps:
    I. The provision of the coated steel substrate according to anyone of claims 1 to 14 or obtainable according to anyone of claims 15 to 19,

II. The reheating of the coated steel substrate in a reheating furnace having an atmosphere containing oxygen with a temperature between 850 and 1400°C,

III. Optionally, the descaling of the reheated coated steel substrate obtained in step II) and

IV. Optionally, the hot-forming of the descaled steel product.

21. A method according to claim 20, wherein in step II), the reheating is performed at a temperature between 1200 and 1400°C.

22. A method according to claim 20 or 21, wherein in step IV), the hot forming is a hot-rolling, hot-extrusion, hot-stamping or hot bending.

23. A steel product obtainable from the method according to anyone of claims 20 to 22 comprising a decreasing chromium gradient starting from the steel product surface, said steel product being optionally coated with an alloyed coating layer comprising aluminum, chromium, the balance being iron directly topped by an oxide layer comprising at least aluminum oxide, the alloyed coating layer and steel being alloyed through diffusion.

24. A steel product according to claim 23, wherein the steel product comprises:

- a first region starting from the steel product surface comprising above 5.0wt.% of chromium and

- a second region starting from the first region comprising below 5.0wt% of chromium.

25. A steel product according to claim 23 or 24, wherein the steel product comprises below 15wt.% of chromium in the first region extending from the steel surface.

26. A steel product according to anyone of claims 23 to 25, wherein the steel product is hot formed.

27. A steel product according to claim 26, wherein the steel product is hot rolled, hot extruded, hot stamped or hot bended

28. A steel product according to claim 27, wherein the steel product is chosen from: a piling, a wire, a rod, a plate, a tube, a rail , a corner, a profile and a beam.

29. Use of the steel product according to anyone of claims 23 to 28 or obtainable according to anyone of claims 20 or 22, for the manufacture of offshore structure, offshore wind power, marine current power, hull of a boat, coastal and port infrastructure, quay wall, underground structure, rail and anchorage.

Figure 1

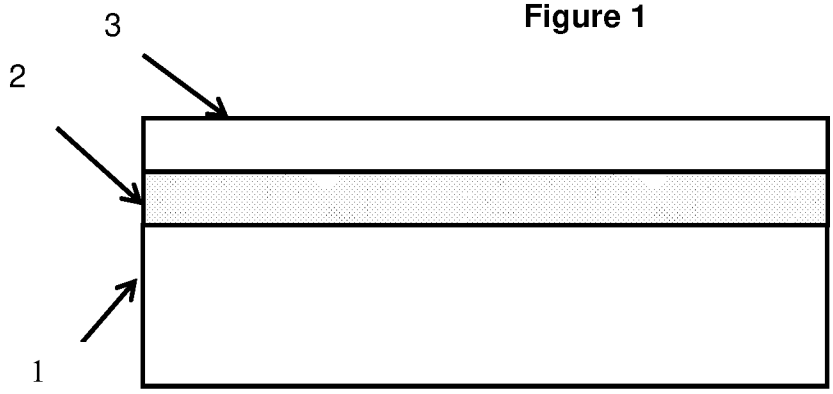


Figure 2

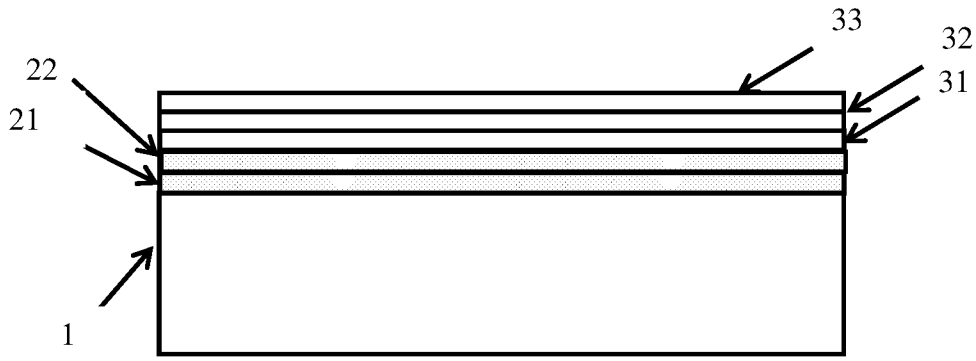
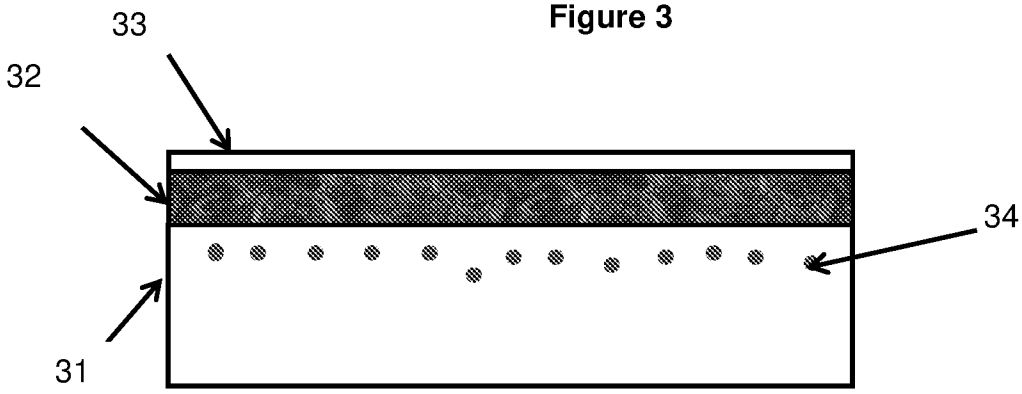


Figure 3



INTERNATIONAL SEARCH REPORT

International application No
PCT/IB2019/052260

A. CLASSIFICATION OF SUBJECT MATTER
INV. C23C2/00 C23C10/32 C23C10/40 C23C14/00 C23C16/00
C23C22/00 C23C24/04
ADD.
According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
C23C

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)
EPO-Internal, WPI Data

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	EP 0 584 364 A1 (NISSHIN STEEL CO LTD [JP]) 2 March 1994 (1994-03-02)	1-22
A	the whole document	23-29

X	JP H04 13862 A (KOBE STEEL LTD) 17 January 1992 (1992-01-17) cited in the application	23-29
A	the whole document	1-22

X	JP H02 236272 A (KOBE STEEL LTD) 19 September 1990 (1990-09-19) cited in the application	23-29
A	the whole document	1-22

A	US 7 132 130 B1 (INNOVATIVE SYSTEMS ENGINEERING [US]) 7 November 2006 (2006-11-07) the whole document	1-29

☐ Further documents are listed in the continuation of Box C.

☒ See patent family annex.

* Special categories of cited documents :

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Date of the actual completion of the international search	Date of mailing of the international search report
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Name and mailing address of the ISA/	Authorized officer
European Patent Office, P.B. 5818 Patentlaan 2 NL - 2280 HV Rijswijk Tel. (+31-70) 340-2040, Fax: (+31-70) 340-3016	Brown, Andrew

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No
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