

C23C

COATING METALLIC MATERIAL; COATING MATERIAL WITH METALLIC MATERIAL; SURFACE TREATMENT OF METALLIC MATERIAL BY DIFFUSION INTO THE SURFACE, BY CHEMICAL CONVERSION OR SUBSTITUTION; COATING BY VACUUM EVAPORATION, BY SPUTTERING, BY ION IMPLANTATION OR BY CHEMICAL VAPOUR DEPOSITION, IN GENERAL (making metal-coated products by extrusion [B21C 23/22](#); covering with metal by connecting pre-existing layers to articles, see the relevant places, e.g. [B21D 39/00](#), [B23K](#); metallising of glass [C03C](#); metallising mortars, concrete, artificial stone, ceramics or natural stone [C04B 41/00](#); enamelling of, or applying a vitreous layer to, metals [C23D](#); treating metal surfaces or coating of metals by electrolysis or electrophoresis [C25D](#); single-crystal film growth [C30B](#); by metallising textiles [D06M 11/83](#); decorating textiles by locally metallising [D06Q 1/04](#))

Definition statement

This place covers:

Hot-dipping or immersion processes and apparatus for applying the coating material in the molten state without affecting the shape.

Coating by spraying, casting, by vacuum evaporation, by sputtering or by ion implantation and the different aspects of chemical coating which includes

Chemical coating by decomposition of either gaseous compounds, liquid or solid compounds, solutions or suspensions of the coating forming compounds, without leaving reaction products of surface material in the coating.

Coating starting from inorganic powder.

Coating with metallic material characterized only by the composition of the metallic material.

Chemical surface treatment of metallic materials, leaving reaction products of surface material in the coating.

All coatings referred to in this subclass are either "for metallic materials" or "by metallic material," with the exception of PVD (by vacuum evaporation, by sputtering or by ion implantation), and CVD (an aspect included in "the different aspects of chemical coating").

Solid state diffusion into metallic material surfaces.

Relationships with other classification places

Applying liquids or other fluent materials to surfaces in general are classified in [B05](#); while [C23C](#) includes the coating of metallic material and the coating material with metallic material.

Making metal-coated products by extrusion is classified in [B21C 23/22](#) while [C23C](#) includes surface treatment of metallic material by diffusion into the surface.

Metallizing of glass is classified in [C03C](#) and Metallizing mortars, concrete, artificial stone, ceramics or natural stone is classified in [C04B 41/00](#).

Coating with paints, varnishes, lacquers is classified in [C09D](#).

Covering with metal by connecting pre-existing layers to articles, see the relevant places, e.g. [B21D 39/00](#), [B23K](#).

Relationships with other classification places

Processes for the electrolytic or electrophoretic production of coatings are classified in [C25D](#).

Processes for the electrolytic removal of materials from objects are classified in [C25F](#).

Enameling of or applying a vitreous layer to, metals is classified in [C23D](#).

Inhibiting corrosion of metallic material or incrustation in general is classified in [C23F](#).

Cleaning or de-greasing of metallic material by chemical methods other than electrolysis, e.g. cleaning, pickling are classified in [C23G](#)

References

Limiting references

This place does not cover:

Making metal-coated products by extrusion	B21C 23/22
Covering with metal by connecting pre-existing layers to articles	B21D 39/00 , B23K
Metallizing of glass	C03C
Metallizing mortars, concrete, artificial stone, ceramics or natural stone	C04B 41/00
Enameling of, or applying a vitreous layer to, metals	C23D
Treating metal surfaces or coating of metals by electrolysis or electrophoresis	C25D
Single-crystal film growth	C30B
Metallizing textiles	D06M 11/83
Decorating textiles by locally metallizing	D06Q 1/04

Informative references

Attention is drawn to the following places, which may be of interest for search:

Applying liquids or other fluent materials to surfaces in general	B05
Casting for building up linings or coverings	B22D 19/08
Casting by dipping	B22D 23/04
Working of metal by the action of a high concentration of electric current on a work piece using an electrode	B23H
Coating of shapes articles of macromolecular compounds	C08J 7/04
Paints, varnishes, lacquers	C09D
Inhibiting corrosion of metallic material or incrustation in general	C23F
Processes for the electrolytic removal of materials from objects	C25F
Details of scanning-probe apparatus, in general	G01Q
Manufacture of semiconductor devices	H01L , H10
Manufacture of printed circuits	H05K

Special rules of classification

In this subclass, an operation is considered as pretreatment or after-treatment when it is specially adapted for, but quite distinct from, the coating process concerned and constitutes an independent operation. If an operation results in the formation of a permanent sub-layer or upper layer, it is

considered as pre-treatment or after-treatment only if it has a direct impact on the layer above or below respectively.

Glossary of terms

In this place, the following terms or expressions are used with the meaning indicated:

Metallic Material	covers: Metals; Alloys which are metallic composite materials containing a substantial proportion of fibers or other somewhat larger particles; ceramic compositions containing free metal bonded to carbides, diamond, oxides, borides, nitrides or silicides, e.g. cermets, or other metal compounds, e.g. oxynitrides or sulfides, other than as macroscopic reinforcing agents.
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C23C 2/00

Hot-dipping or immersion processes for applying the coating material in the molten state without affecting the shape; Apparatus therefor

Definition statement

This place covers:

Metallic coatings obtained by dipping or immersing a substrate into a molten bath of the coating material, where the substrate itself remains essentially unchanged, as well as any methods and/or apparatuses specifically used thereof.

Relationships with other classification places

Enameling of, or applying a vitreous layer to metals is classified in [C23D 5/00](#).

Formation of mono or polycrystalline Si coatings by pulling high temperature resistant wires and/or sheets through molten silicon is classified in [C30B 29/06](#).

Single-crystal growth by pulling from a melt, pulling on a substrate [C30B 15/007](#).

Production of homogeneous polycrystalline material with defined structure, from liquids, by pulling from a melt [C30B 28/10](#).

References

Informative references

Attention is drawn to the following places, which may be of interest for search:

Casting molten material on the substrate	C23C 6/00
Control devices or methods specially adapted for metal-rolling mills	B21B 37/00
Manufacture of coated wire or bars	B21C 37/042
Of tubes or metal hoses; Combined procedures for making tubes, e.g. for making multi-wall tubes	B21C 37/06
Using rods or strips of soldering material	B21C 37/087
Of coated strip material	B21C 37/09
Layered products essentially comprising metal	B32B 15/00
Controlling or regulating thickness in general	G05D 5/02

Special rules of classification

Classification is given to well disclosed coatings and/or processes. Classification is further given to related processes, such as pre-treatment(s) of the substrate or after-treatment(s) of the coating. Classification is also further given to apparatus features important to the coating process.

In this main group, an operation is considered as pre-treatment or after-treatment when it is specially adapted for, but quite distinct from, the coating process concerned and constitutes an independent operation.

All well-disclosed, non-trivial examples of processes and/or coatings are classified. Precedence rules indicated in the headers of the subgroups are to be strictly followed, e.g. removal by air knives of an excess of molten material on a strip is to be classified only in [C23C 2/20](#), and not also in [C23C 2/26](#) and [C23C 2/40](#).

Alloys based on a given metal are alloys where said metal makes up at least 50% by weight of said alloy (see in particular [C23C 2/06](#), [C23C 2/08](#), [C23C 2/10](#) and [C23C 2/12](#)).

Magnetic energy being applied to the system is classified based upon the intended effect of the magnetic energy on the system.

[C23C 2/00362](#) covers the use of magnetic energy to effect sealing or otherwise containing the molten material within the container at an opening in the wall which the substrate travels.

[C23C 2/24](#) covers the use of magnetic or electric fields energy to remove excess molten coating or to otherwise control the thickness of the coating applied to the substrate after the substrate exits the coating bath.

[C23C 2/32](#) covers the use of magnetic energy to cause vibrations of the liquid metal in the bath for stirring purposes etc. or the substrate while in the molten bath.

[C23C 2/5245](#) covers the use of magnetic energy to reduce vibrations of the substrate travelling through the bath.

Glossary of terms

In this place, the following terms or expressions are used with the meaning indicated:

Metallic material	Metals and metals alloys, also including inorganic materials such as oxides, carbides, nitrides, borides, silicides and their mixtures
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C23C 2/0034

{Details related to elements immersed in bath}

Definition statement

This place covers:

Elements that are immersed within the bath, such as walls, baffles, pumps, elements supporting the substrate during coating or elements for moving the substrate through the bath. Non-moving immersed elements are classified here.

C23C 2/00342**{Moving elements, e.g. pumps or mixers}****Definition statement***This place covers:*

Elements that are immersed within the bath which are in motion relative to the bath, such as pumps (i.e. the internal impeller moves relative to the bath), mixers, impellers, rollers or bearings.

Special rules of classification

Devices for mixing or stirring of the bath with control or regulation should also be classified in [C23C 2/54](#), [C23C 2/542](#) or [C23C 2/544](#) as appropriate.

C23C 2/00344**{Means for moving substrates, e.g. immersed rollers or immersed bearings}****Definition statement***This place covers:*

Elements that are immersed within the bath and act to force movement of the substrate through the bath, such as rollers or portions thereof, e.g. bearings.

C23C 2/0035**{Means for continuously moving substrate through, into or out of the bath
([C23C 2/00344](#) takes precedence)}****Definition statement***This place covers:*

Elements that act upon the substrate to be coated to move the substrate through the bath, such as take-up rollers or supply rollers.

References**Limiting references***This place does not cover:*

Rollers immersed within the bath	C23C 2/00344
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C23C 2/0036**{Crucibles}****Definition statement***This place covers:*

Crucibles and heating devices. This area also covers the vessel for a holding bath.

C23C 2/00361

{characterised by structures including means for immersing or extracting the substrate through confining wall area}

Glossary of terms

In this place, the following terms or expressions are used with the meaning indicated:

Wall	Any portion of the receptacle which confines the bath is located below the upper surface of the bath and may include a side wall as well as a floor of the receptacle which the substrate passes through
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C23C 2/0038

{characterised by the pre-treatment chambers located immediately upstream of the bath or occurring locally before the dipping process}

Definition statement

This place covers:

Pre-treatment chamber(s), and elements thereof, that are directly associated with the hot-dipping or immersion apparatus, such as specific structure of pretreatment chamber(s), chamber mechanisms, transportation mechanism, seals, or heat or atmospheric conditions.

Glossary of terms

In this place, the following terms or expressions are used with the meaning indicated:

Locally	The same physical location, e.g. plant, so as to exclude pre-treatment chamber(s) which treat a substrate which then require shipping the pre-treated substrate from one location to another
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C23C 2/004

{Snouts}

Definition statement

This place covers:

Fixed enclosures between the furnace and the molten metal bath.

C23C 2/006

{Pattern or selective deposits}

Definition statement

This place covers:

Processes or devices for conducting patterned or selective deposition on the substrate.

C23C 2/0062

{without pre-treatment of the material to be coated, e.g. using masking elements such as casings, shields, fixtures or blocking elements}

Definition statement

This place covers:

Methods or devices for forming patterned or selective deposition by means external to the substrate, e.g. using masking elements such as casings, shields, fixtures or blocking elements.

C23C 2/0064

{using masking layers}

Definition statement

This place covers:

Pattern or selective deposition done by means of applying a masking layer to the substrate.

C23C 2/02

Pretreatment of the material to be coated, e.g. for coating on selected surface areas ([C23C 2/30](#) takes precedence)

Definition statement

This place covers:

Pre-treatment of the material to be coated, an operation being considered as pre-treatment when it is specially adapted for, but quite distinct from, the coating process concerned and constitutes an independent operation.

For example:

- Cleaning or etching treatments
- Physical treatments such as roughening, grinding or polishing
- Deposition of sublayers, i.e. adhesion layers, masking layers

References**Limiting references**

This place does not cover:

Fluxes or coverings on molten baths	C23C 2/30
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Informative references

Attention is drawn to the following places, which may be of interest for search:

Pre-treatment of metallic material, by etching with chemical means	C23F 1/00
Pre-treatment of metallic material, by cleaning/pickling/degreasing	C23G 1/00 , C23G 5/00

Special rules of classification

For pre-treatments (e.g. cold or hot rolling or heat treatments) that are covered by [C21D](#) and/or [C22F](#), an allocation is made in both [C23C 2/02](#) and the relevant subgroups in [C21D](#) and/or [C22F](#).

C23C 2/026

{Deposition of sublayers, e.g. adhesion layers or pre-applied alloying elements or corrosion protection}

Definition statement

This place covers:

Application of complete or partial layers onto the substrate to be coated prior to entry into the bath. Examples of these layers are adhesion layers that promote adhesion between the substrate and the bath material, pre-applied alloying elements that mix with the bath material in the coating, and layers that protect the substrate from corrosion prior to entry into the bath.

Special rules of classification

Masking layers for forming patterned or selective deposition are not considered sub-layers and are classified in [C23C 2/0064](#).

C23C 2/14

Removing excess of molten coatings; Controlling or regulating the coating thickness

References

Informative references

Attention is drawn to the following places, which may be of interest for search:

Controlling or regulating thickness in general	G05D 5/02
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C23C 2/16

using fluids under pressure, e.g. air knives

References

Informative references

Attention is drawn to the following places, which may be of interest for search:

Apparatus for spreading or distributing liquids or other fluent materials already applied to a surface with a blast of gas or vapour	B05C 11/06
Machines or apparatus for drying objects with progressive movement	F26B 15/00

C23C 2/30

Fluxes or coverings on molten baths ([C23C 2/22](#) takes precedence)

Definition statement

This place covers:

Fluxes or covering materials for molten baths, e.g. fluxes materials used in hot dipping process

References

Limiting references

This place does not cover:

Removing excess of molten coatings from elongated material by rubbing	C23C 2/22
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Glossary of terms

In this place, the following terms or expressions are used with the meaning indicated:

Covering	A chemical compound and/or composition, usually immiscible with the melt and having a lower density, i.e. not a physical object.
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C23C 2/32

using vibratory energy applied to the bath or substrate ([C23C 2/14](#) takes precedence)

Definition statement

This place covers:

Application of vibrations using physical, magnetic or other means to the bath or to the substrate. An example of subject matter covered by this group is the use of ultrasonic energy to a substrate to cause vibrations of the substrate to enhance wettability of the substrate.

Special rules of classification

Application of vibratory energy to remove excess coating material is classified in [C23C 2/14](#).

C23C 2/325

{Processes or devices for cleaning the bath}

Definition statement

This place covers:

Processes for cleaning of the bath and the devices that perform the cleaning.

"Cleaning" is intended to cover removal, by chemical or physical means, of impurities within the bath, such as devices which skim material from the surface of the bath or which remove a portion of the bath for treatment to remove impurities before returning the treated portion to the bath.

C23C 2/51

{Computer-controlled implementation}

Definition statement

This place covers:

Control or regulation of the coating process, wherein the control or regulation is performed responsive by a computer.

Examples include standard PID controllers, "fuzzy" logic controllers and artificial intelligence or machine-learning implemented control of the coating process.

Special rules of classification

This subgroup should be used in combination with any appropriate subgroups that are also indented under [C23C 2/50](#).

C23C 2/52

{with means for measuring or sensing}

Definition statement

This place covers:

Control or regulation of the coating process wherein at least one variable is measured or sensed.

"Measured or sensed" includes both electronic and mechanical detection of variables, as well as "measuring or sensing" by an operator of the coating process, such as visual inspection of the variable of the coating process.

C23C 2/524

{Position of the substrate}

Definition statement

This place covers:

Measuring or sensing the position of the substrate, which includes at least the location of the substrate with respect to fixed portions of the coating apparatus and any change in the location of the substrate over time, e.g. vibration of the substrate.

C23C 2/526

{for visually inspecting the surface quality of the substrate}

Definition statement

This place covers:

Using image processing techniques to investigate the surface quality of the substrate.

C23C 2/54

{of the mixing or stirring the bath}

Definition statement

This place covers:

Methods or devices for controlling or regulating the mixing or stirring of the bath.

Special rules of classification

Devices for mixing or stirring of the bath without control or regulation are classified in [C23C 2/003](#) or in [C23C 2/00342](#) as appropriate.

C23C 4/00

Coating by spraying the coating material in the molten state, e.g. by flame, plasma or electric discharge (build-up welding [B23K](#), e.g. [B23K 5/18](#), [B23K 9/04](#))

Definition statement

This place covers:

Coating processes in which melted or partially melted materials are sprayed, i.e. propelled, onto a surface, as well as apparatuses specifically used thereof.

The material to be deposited is typically fed into the spray gun in powder, wire or rod form where it is rapidly heated and melted or partially melted by electrical (plasma or arc) or chemical means (combustion flame, detonation), before being accelerated towards the substrate to be coated.

The obtained coatings are characterized by a lamellar grain structure resulting from the rapid solidification of small globules, flattened from striking a cold surface at high velocities.

Relationships with other classification places

Protective layers or coatings deposited by spraying for specific articles is classified in this group and also classified in the appropriate places for said specific articles, e.g. [F01D 5/288](#) for protective coatings for turbine blades; [F28F 19/02](#), [F28F 19/06](#) for protective coatings for heat exchangers; [A61L 27/28](#) for coating materials for prostheses; [B22C 3/00](#) for coating compositions for surfaces of moulds, cores or patterns.

References

Limiting references

This place does not cover:

Build-up welding	B23K , e.g. B23K 5/18 , B23K 9/04
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Informative references

Attention is drawn to the following places, which may be of interest for search:

Coating by simply casting molten material on the substrate	C23C 6/00
Spraying of powders in which no significant melting occurs before reaching the substrate	C23C 24/04
Coating materials for prostheses	A61L 27/28
Apparatus for spraying by means of detonations in general	B05B 7/0006
Apparatus for spraying by means of flame in general	B05B 7/20
Apparatus for spraying by means of electric arc in general	B05B 7/22 , B05B 7/222 , B05B 7/224 , B05B 7/226
Control of spray area by means of masking elements	B05B 12/20
Coating compositions for surfaces of moulds, cores or patterns	B22C 3/00
Making alloys containing fibres or filaments by thermal spraying of metal	C22C 47/16
Enamelling of, or applying a vitreous layer to, metals	C23D 5/00
Protective coatings for turbine blades	F01D 5/288 , F05C 2253/12

Protective coatings for heat exchangers	F28F 19/02
Plasma torches in general	H05H 1/26

Special rules of classification

Classes are given to well disclosed coatings and/or methods. Classes are further given to related methods, such as pre-treatment(s) of the substrate or after-treatment(s) of the coating. Classes are also further given to apparatus features important to the coating method.

In this main group, an operation is considered as pre-treatment or after-treatment when it is specially adapted for, but quite distinct from, the coating process concerned and constitutes an independent operation.

All well-disclosed, non-trivial examples of methods and/or coatings are classified.

Precedence rules indicated in the headers of the subgroups are to be strictly followed.

Glossary of terms

In this place, the following terms or expressions are used with the meaning indicated:

Metallic material	Metals and metals alloys, also including inorganic materials such as oxides, carbides, nitrides, borides, silicides and their mixtures
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Synonyms and Keywords

In patent documents, the following abbreviations are often used:

APS	Air plasma spraying
HVOF	High velocity oxygen fuel
HPPS	High pressure plasma spraying
IGPS	Inert gas plasma spraying
IPS	Inductive plasma spraying
LPPS	Low pressure plasma spraying
VPS	Vacuum plasma spraying

C23C 4/01

Selective coating, e.g. pattern coating, without pre-treatment of the material to be coated

Definition statement

This place covers:

Masking elements such as casings, shields, fixtures or blocking elements.

Stripping foreign matter from cavities by means of gas or water jets.

C23C 4/02

Pretreatment of the material to be coated, e.g. for coating on selected surface areas

Definition statement

This place covers:

Pre-treatment of the material to be coated, an operation being considered as pre-treatment when it is specially adapted for, but quite distinct from, the coating process concerned and constitutes an independent operation.

For example:

- Cleaning or etching treatments
- Physical treatments such as roughening, grinding or polishing
- Deposition of sublayers, i.e. adhesion layers, masking layers

References

Informative references

Attention is drawn to the following places, which may be of interest for search:

Pretreatment of metallic material, by etching with chemical means	C23F 1/00
Pretreatment of metallic material, by cleaning/pickling/degreasing	C23G 1/00 , C23G 5/00

Special rules of classification

Only methods which are specially adapted for, but quite distinct from the main spraying coating process, and which result in sublayers having a direct impact on the main coating layer either above (e.g. adhesion) or below (e.g. masking) should be classified in this group.

Sprayed bond coats for thermal barrier coatings (TBC) are only to be classified if the TBC is also sprayed and the bond coat is well-defined and/or exhibiting unusual characteristics.

C23C 4/04

characterised by the coating material

Definition statement

This place covers:

Spraying the coating material characterised by the coating composition that is not covered by the subgroups

Special rules of classification

All specific and well-defined coating compositions should be classified in the relevant subgroups, [C23C 4/06](#) - [C23C 4/11](#).

C23C 4/06

Metallic material

Definition statement

This place covers:

Metals and metal alloys compositions mixed with inorganic hard particles such as oxides, borides, carbides, nitrides and/or silicides.

References

Limiting references

This place does not cover:

MCrAl(Y) alloys where M is nickel, cobalt or iron as coating material with or without non-metal elements, e.g. silicon.	C23C 4/073
Pure metals or metal alloys as coating material	C23C 4/08
Pure oxides, borides, carbides, nitrides, silicides or their mixtures as coating material	C23C 4/10
Pure oxide compositions as coating material	C23C 4/11

C23C 4/073

containing MCrAl or MCrAlY alloys, where M is nickel, cobalt or iron, with or without non-metal elements

Definition statement

This place covers:

MCrAl or MCrAlY alloys, also when further elements are present in said alloys, e.g. Si, ..., and/or hard particles.

C23C 4/08

containing only metal elements ([C23C 4/073](#) takes precedence)

Definition statement

This place covers:

Pure metals or metal alloys compositions.

References

Limiting references

This place does not cover:

MCrAl(Y) alloys where M is nickel, cobalt or iron as coating material with or without non-metal elements, e.g. silicon.	C23C 4/073
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C23C 4/10

Oxides, borides, carbides, nitrides or silicides; Mixtures thereof

Definition statement

This place covers:

Compositions including mixtures of any two or more of oxides, borides, carbides, nitrides and/or silicides, or pure borides, carbides, nitrides or silicides compositions.

References

Limiting references

This place does not cover:

Pure oxides compositions as coating material	C23C 4/11
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C23C 4/11

Oxides

Definition statement

This place covers:

Pure oxides compositions

Synonyms and Keywords

In patent documents, the following abbreviations are often used:

PSZ	Partially Stabilized Zirconia
PLZT	Lead Lanthanum Zirconate Titanate
PZT	Lead Zirconate Titanate
YSZ	Ytria Stabilized Zirconia

C23C 4/12

characterised by the method of spraying

Definition statement

This place covers:

Coating processes characterised by the method of spraying being not covered by the subgroups.

Special rules of classification

All specific and well-defined methods and/or apparatuses should be classified in the relevant subgroups, [C23C 4/123](#) - [C23C 4/137](#).

C23C 4/123

Spraying molten metal

Definition statement

This place covers:

Processes and apparatuses in which the material to be deposited is melted in a furnace, then the molten material is slowly poured through a conical tundish into a small-bore ceramic nozzle. The molten material exits the furnace as a thin free-falling stream and is broken up into droplets by an annular array of gas jets, and these droplets then proceed downwards, accelerated by the gas jets to impact onto a substrate.

References

Limiting references

This place does not cover:

Dipping in a molten bath	C23C 2/00
Casting molten material on a substrate	C23C 6/00
Continuous casting of metals	B22D 11/00

C23C 4/126

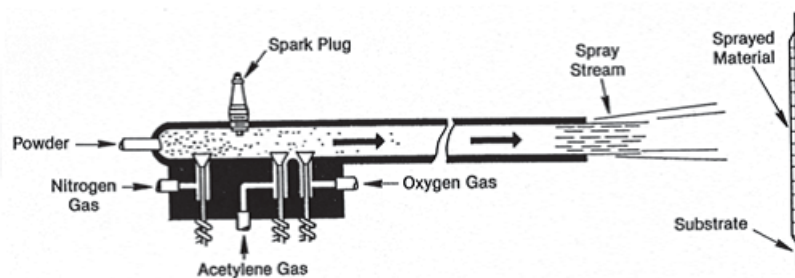
Detonation spraying

Definition statement

This place covers:

Processes and apparatuses where oxygen and fuel is fed into a barrel along with a charge of powder of the material to be deposited. A spark is used to ignite the gas mixture and the resulting detonation heats and accelerates the powder to supersonic velocity down the barrel, to deposit on the substrate.

Schematic diagram of a detonation process:



References

Informative references

Attention is drawn to the following places, which may be of interest for search:

Apparatus for spraying by means of detonations in general	B05B 7/0006
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C23C 4/129

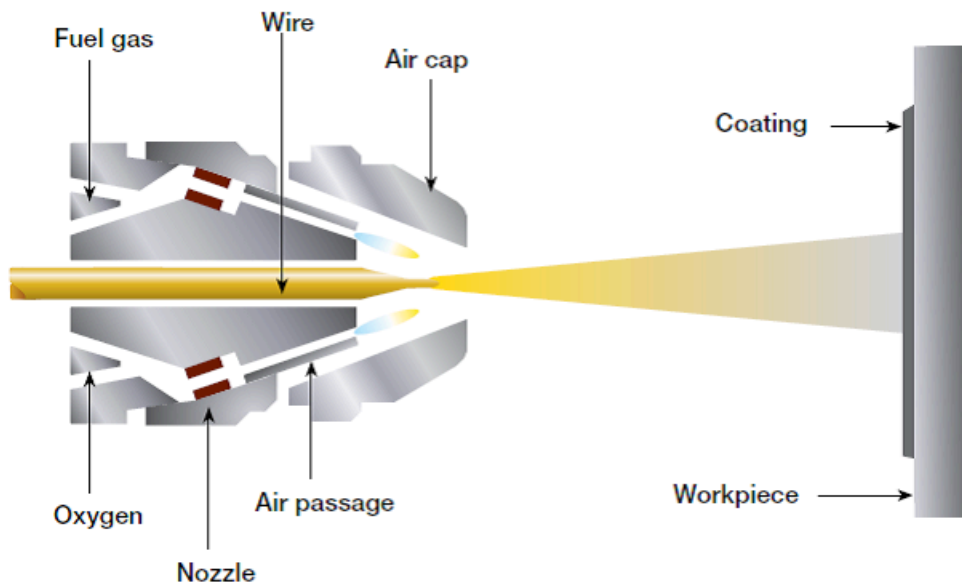
Flame spraying

Definition statement

This place covers:

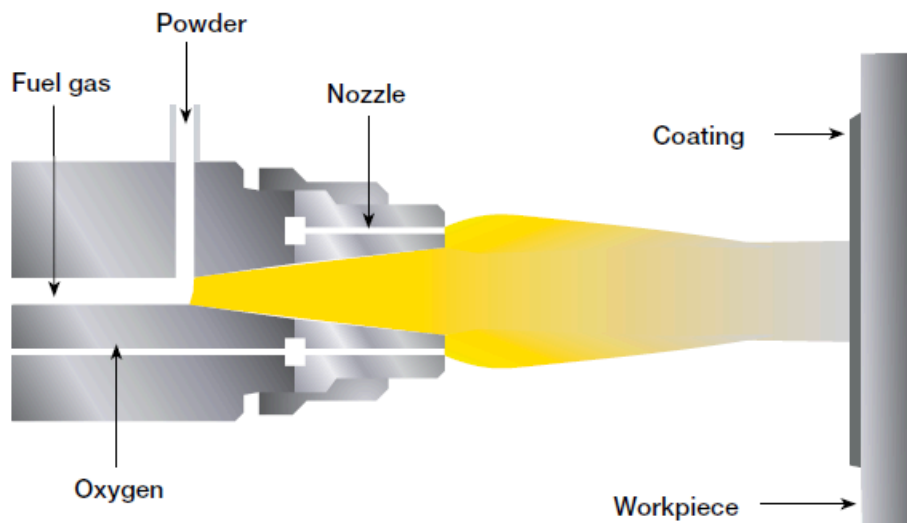
Processes and apparatuses in which the spray material, in form of a powder or a wire, is fed continually into a fuel gas-oxygen flame where it is typically melted by the heat of combustion. A powder feed carrier gas transports the powder particles into the combustion flame, and the mixed gases transport the material towards the prepared workpiece surface.

Schematic diagram of a wire flame process:



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Schematic diagram of a powder flame process:



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References

Informative references

Attention is drawn to the following places, which may be of interest for search:

Apparatus for spraying by means of flame in general	B05B 7/20
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C23C 4/131

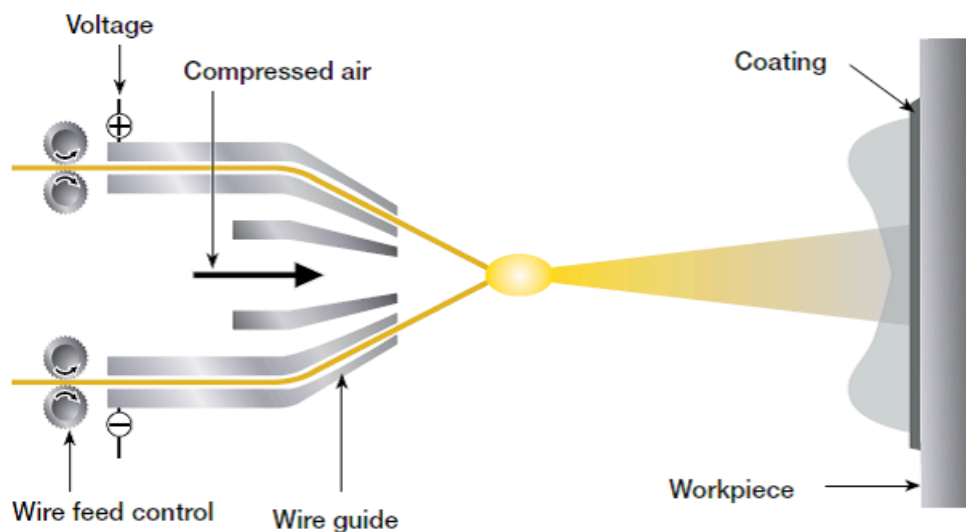
Wire arc spraying

Definition statement

This place covers:

Processes and apparatuses using two metallic wires, usually of the same composition, as the coating feedstock. The two wires are electrically charged with opposing polarity and are fed into the arc gun at matched, controlled speeds. When the wires are brought together at the contact point, the opposing charges on the wires create enough heat to continuously melt the tips of the wires. Compressed air is used to atomize the now molten material and accelerate it onto the workpiece surface to form the coating.

Schematic diagram of a wire arc process:



© Sulzer Metco

References

Informative references

Attention is drawn to the following places, which may be of interest for search:

Apparatus for spraying by means of electric arc	B05B 7/222 , B05B 7/224 , B05B 7/226
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C23C 4/134

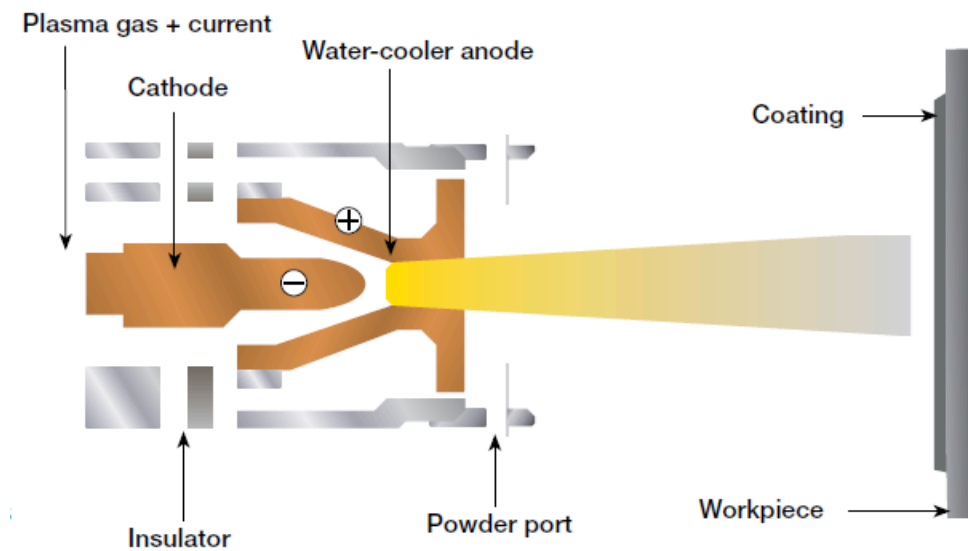
Plasma spraying

Definition statement

This place covers:

Processes and apparatuses where an electric arc is generated between an anode and a cathode. This ionizes the flowing process gases into the plasma state. Powdered feedstock material is injected into the plasma jet, melting the powder particles and propelling them to the surface of the workpiece.

Schematic diagram of a plasma spray process:



© Sulzer Metco

References

Informative references

Attention is drawn to the following places, which may be of interest for search:

Apparatus for spraying by means of electric arc in general	B05B 7/22
Plasma torches in general	H05H 1/26

C23C 4/137

Spraying in vacuum or in an inert atmosphere

Definition statement

This place covers:

Coating by spraying in vacuum or in an inert gas chamber the coating material in the molten state, for example:

Spraying at below atmospheric pressure

Spraying using inert gas shrouds or in enclosures filled with inert gas

Synonyms and Keywords

In patent documents, the following abbreviations are often used:

IGPS	Inert Gas Plasma Spraying
IPS	Inductive Plasma Spraying
LPPS	Low Pressure Plasma Spraying
VPS	Vacuum Plasma Spraying

C23C 6/00

Coating by casting molten material on the substrate

Definition statement

This place covers:

Processes and apparatuses involving pouring molten, i.e. liquid, material onto a substrate to form a coating.

References

Limiting references

This place does not cover:

Dipping in a molten metal bath	C23C 2/00
Spraying molten metals	C23C 4/123
Casting molten macromolecular compounds, i.e. polymers, on a substrate	B05C 5/00 , B05D 7/00
Enamelling of, or applying a vitreous layer to, metals	C23D 5/00

Informative references

Attention is drawn to the following places, which may be of interest for search:

Continuous casting of metals	B22D 11/00
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Glossary of terms

In this place, the following terms or expressions are used with the meaning indicated:

Material	Metals and metals alloys, also including inorganic materials such as oxides, carbides, nitrides, borides, silicides and their mixtures
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C23C 8/00

Solid state diffusion of only non-metal elements into metallic material surfaces (diffusion of silicon [C23C 10/00](#)); Chemical surface treatment of metallic material by reaction of the surface with a reactive gas, leaving reaction products of surface material in the coating, e.g. conversion coatings, passivation of metals ([C23C 14/00](#) takes precedence)

Definition statement

This place covers:

The diffusion of non-metal elements such as carbon, oxygen, nitrogen, but also boron, phosphor, sulfur, selenium or tellurium into a metal or metal alloy surface by contact with either a reactive gas (e.g. oxygen, hydrocarbons, nitrogen), a liquid (e.g. salt melts) or a solid (e.g. powders, pastes).

Coatings obtained by oxidising, carburising, nitriding, carbo-nitriding and/or boronising a metal or metal alloy surface.

References

Limiting references

This place does not cover:

Diffusion of only metal elements or silicon into a metallic surface	C23C 10/00
Diffusion of at least one non-metal element other than silicon and at least one metal element or silicon into metallic material surfaces	C23C 12/00
Coating by evaporation, by sputtering or by ion implantation of the coating forming material	C23C 14/00
Reactive after treatment of PVD coatings with sulfur, selenium and/or tellurium	C23C 14/5866
Electroless plating	C23C 18/00
Conversion or passivation coatings obtained by reaction of the metallic surface with a reactive liquid, e.g. chromate, phosphate and/or silicate conversion coatings	C23C 22/00
Conversion coatings obtained by electrolytic surface reaction, e.g. anodisation, phosphatising, chromatising	C25D 11/00
Process or apparatus specially adapted for the manufacture or treatment of semiconductor devices, e.g. doping of semiconductors	H01L 21/00

Informative references

Attention is drawn to the following places, which may be of interest for search:

General methods or devices for heat treatment of ferrous or non-ferrous metals or alloys	C21D 1/00
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Special rules of classification

Classes are given to well disclosed coatings and/or methods. Classes are further given to related methods, such as pre-treatment(s) of the substrate or after-treatment(s) of the coating.

An operation is considered as pre-treatment or after-treatment when it is specially adapted for, but quite distinct from, the coating process concerned and constitutes an independent operation.

All well-disclosed, non-trivial examples of methods and/or coating are classified.

Precedence rules indicated in the headers of the subgroups are to be strictly followed.

Glossary of terms

In this place, the following terms or expressions are used with the meaning indicated:

Ferrous surfaces	Surfaces containing a majority of iron per weight, such as but not limited to steel and cast iron
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C23C 8/02

Pretreatment of the material to be coated ([C23C 8/04](#) takes precedence)

Definition statement

This place covers:

Cleaning or etching treatments

Physical treatments such as roughening, grinding or polishing

Deposition of sublayers, i.e. adhesion layers, masking layers

References

Informative references

Attention is drawn to the following places, which may be of interest for search:

Pre-treatment of metallic material, by etching with chemical means	C23F 1/00
Pre-treatment of metallic material, by cleaning/pickling/degreasing	C23G 1/00 , C23G 5/00

C23C 8/04

Treatment of selected surface areas, e.g. using masks

Definition statement

This place covers:

Masking elements such as casings, shields, fixtures or blocking elements, as well as masking layers or tapes.

Treatments on selected surface areas also not involving masking elements.

C23C 8/36

using ionised gases, e.g. ionitriding

Definition statement

This place covers:

Treatment of the metallic surface with ionised gases, leaving reaction products of surface material in the coating, e.g. ionitriding..

References

Informative references

Attention is drawn to the following places, which may be of interest for search:

Coating by evaporation, sputtering or ion implantation	C23C 14/00
Chemical vapour deposition	C23C 16/00
Discharge tubes with provision for introducing objects or material to be exposed to the discharge	H01J 37/00

C23C 10/00

Solid state diffusion of only metal elements or silicon into metallic material surfaces

Definition statement

This place covers:

The diffusion of metal elements or silicon into a metal or metal alloy surface by contact with either a reactive gas, a liquid (e.g. salt or metal melts) or a solid (e.g. powders, pastes).

References

Limiting references

This place does not cover:

Diffusion of non-metal elements other than silicon into a metal or metal alloy surface	C23C 8/00
Diffusion of at least one non-metal element other than silicon and at least one metal element or silicon into metallic material surfaces	C23C 12/00
Coating by evaporation, by sputtering or by ion implantation of the coating forming material	C23C 14/00
Electroless plating	C23C 18/00
Conversion or passivation coatings obtained by reaction of the metallic surface with a reactive liquid, e.g. chromate, and/or silicate conversion coatings	C23C 22/00
Conversion coatings obtained by electrolytic surface reaction, e.g. anodisation, chromatising	C25D 11/00
Process or apparatus specially adapted for the manufacture or treatment of semiconductor devices, e.g. doping of semiconductors	H01L 21/00

Informative references

Attention is drawn to the following places, which may be of interest for search:

General methods or devices for heat treatment of ferrous or non-ferrous metals or alloys	C21D 1/00
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Special rules of classification

Classes are given to well disclosed coatings and/or methods. Classes are further given to related methods, such as pre-treatment(s) of the substrate or after-treatment(s) of the coating.

An operation is considered as pre-treatment or after-treatment when it is specially adapted for, but quite distinct from, the coating process concerned and constitutes an independent operation.

All well-disclosed, non-trivial examples of methods and/or coatings are classified.

Precedence rules indicated in the headers of the subgroups are to be strictly followed.

Glossary of terms

In this place, the following terms or expressions are used with the meaning indicated:

Ferrous surfaces	Surfaces containing a majority of iron per weight, such as but not limited to steel and cast iron
------------------	---

C23C 10/02

Pretreatment of the material to be coated ([C23C 10/04](#) takes precedence)

Definition statement

This place covers:

Pretreatments of the material to be coated, an operation being considered as pre-treatment when it is specially adapted for, but quite distinct from, the coating process concerned and constitutes an independent operation.

For example:

- Cleaning or etching treatments
- Physical treatments such as roughening, grinding or polishing
- Deposition of sublayers, i.e. adhesion layers, masking layers

References

Informative references

Attention is drawn to the following places, which may be of interest for search:

Pre-treatment of metallic material, by etching with chemical means	C23F 1/00
Pre-treatment of metallic material, by cleaning/pickling/degreasing	C23G 1/00 , C23G 5/00

C23C 10/04

Diffusion into selected surface areas, e.g. using masks

Definition statement

This place covers:

Masking elements such as casings, shields, fixtures or blocking elements, as well as masking layers or tapes.

Treatments on selected surface areas also not involving masking elements.

C23C 12/00

Solid state diffusion of at least one non-metal element other than silicon and at least one metal element or silicon into metallic material surfaces

Definition statement

This place covers:

The diffusion of at least one non-metal elements other than silicon and at least one metal element or silicon into a metal or metal alloy surface by contact with either a reactive gas, a liquid (e.g. salt or metal melts) or a solid (e.g. powders, pastes).

References

Limiting references

This place does not cover:

Diffusion of only non-metal elements other than silicon into a metallic surface	C23C 8/00
Diffusion of only metal elements or silicon into a metallic surface	C23C 10/00
Coating by evaporation, by sputtering or by ion implantation of the coating forming material	C23C 14/00
Electroless plating	C23C 18/00
Conversion or passivation coatings obtained by reaction of the metallic surface with a reactive liquid, e.g. chromate, and/or silicate conversion coatings	C23C 22/00
Conversion coatings obtained by electrolytic surface reaction, e.g. anodisation, chromatising	C25D 11/00
Process or apparatus specially adapted for the manufacture or treatment of semiconductor devices, e.g. doping of semiconductors	H01L 21/00

Informative references

Attention is drawn to the following places, which may be of interest for search:

General methods or devices for heat treatment of ferrous or non-ferrous metals or alloys	C21D 1/00
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C23C 14/00

Coating by vacuum evaporation, by sputtering or by ion implantation of the coating forming material

Definition statement

This place covers:

- Coating by vacuum evaporation, by sputtering or by ion implantation of the coating forming material, e.g. physical vapor deposition (PVD), reactive sputtering.
- Coating material
- Coating processes
- Pre-treatment of the substrate or after-treatment of the coating
- Apparatus features important to the coating method, e.g. crucibles for the source material in PVD

References

Informative references

Attention is drawn to the following places, which may be of interest for search:

Multilayers	C23C 28/00
Deposition of organic layers	B05D 7/00
Cleaning	B08B
Carbon (fullerenes)	C01B 32/00
Surface treatment of glass	C03C 17/00
After-treatment of ceramics	C04B 41/00
Organometallic compounds	C07F
Epitaxial layers	C30B 23/00 , C30B 25/00
Plasma apparatuses	H01J 37/00
Semiconductors	H01L

Special rules of classification

General considerations.

CPC groups are given only as Invention symbols to well disclosed PVD (physical vapor deposition) coating methods.

CPC groups are further given only as Invention symbols to related methods, such as pre-treatment of the substrate or after-treatment of the coating.

CPC groups are further given only as Invention symbols to apparatus features important to the coating method, such as crucibles for the source material in PVD.

Trivial references to well known PVD processes are not classified. As an example "...the SiO₂ layer was deposited by sputtering..." may be mentioned.

In this subclass, an operation is considered as pre-treatment or after-treatment when it is specially adapted for, but quite distinct from, the coating process concerned and constitutes an independent operation.

If an operation results in the formation of a permanent sub-layer or upper layer, it is considered as pre-treatment or after-treatment only if it has a direct impact on the layer above or below respectively.

During classification in [C23C 14/00](#) it is common that a document is vague about some of the subject-matter relating to PVD, making the classifier doubt if the document should be classified or not. The classifier should in these cases be guided by his/her own best judgement and the possible importance of the well disclosed subject-matter.

Specific considerations related to specific parts of the classification scheme:

Most of the groups in [C23C 14/00](#) are self-explanatory. Below some explanation of non obvious aspects.

[C23C 14/0021-C23C 14/0031](#): Material in the gas phase is achieved by evaporation, laser ablation etc and reacted with another gas before or during the coating of the substrate. After-treatment with reactive gas in any form is classified in [C23C 14/5846-C23C 14/5866](#).

[C23C 14/0036-C23C 14/0084](#): Material in the gas phase is achieved by sputtering and reacted with another gas before or during the coating of the substrate. After-treatment with reactive gas in any form

is classified in [C23C 14/5846-C23C 14/5866](#). Note that the sequential processes in [C23C 14/0073](#) and [C23C 14/0078](#) are not considered as after-treatments.

[C23C 14/024-C23C 14/027](#): The sub-layers are classified only if they have a direct relation to the PVD coating above. Examples are improvement of the adhesion or influence on the structure or properties of the PVD coating above.

[C23C 14/04-C23C 14/048](#): Deliberate action to avoid coating of some areas of the substrate. Merely coating of the front side of a substrate directed towards a source of coating material and not coating the side that the substrate rests on is not classified.

[C23C 14/08-C23C 14/088](#): The alkaline earth, refractory and iron group metals are defined in IPC section [C](#) on one of the first pages. Mixed oxides from different groups are classified in [C23C 14/08](#). Mixed oxides from one group is classified in that group. For example Al-Mg-O is classified in [C23C 14/081](#) but Ti-Al-O is classified in [C23C 14/08](#).

[C23C 14/10](#): Note that these materials are usually based on Si-O, but other types of glass should also be classified here.

[C23C 14/22](#): Here, coating processes are classified that does not fit the groups [C23C 14/221-](#)
[C23C 14/48](#). Examples are processes based on a combinations of CVD and PVD and combinations of different PVD processes.

[C23C 14/24-C23C 14/32](#): Some ionization usually takes place during laser ablation ([C23C 14/28](#)) and electron beam induced evaporation ([C23C 14/30](#)). However, these documents are not classified in [C23C 14/32](#) unless further ionization of the evaporated material takes place.

[C23C 14/34-C23C 14/46](#). In [C23C 14/3407](#) it is particularly important to classify the method used for building up the target-backing plate unit. Remember that the features of the electrodes as such are classified in [H01J 37/34](#).

Note further that sputtering may be performed with other particles than ions.

A sputtering process is based on the use of the kinetic energy of a particle impacting a target surface releasing target material that is subsequently deposited on a substrate.

[C23C 14/56](#): Normal vacuum pumping is classified here. Deliberate minimization of impurities is classified in [C23C 14/564](#).

[C23C 14/58-C23C 14/5893C23C 14/58](#) includes after deposition treatment of a coating or film deposited by the techniques of [C23C 14/00](#).

In [C23C 14/5826](#) any treatment with charged particles not being ion beam bombardment is included such as for example plasma treatment.

C23C 14/54

Controlling or regulating the coating process

References

Informative references

Attention is drawn to the following places, which may be of interest for search:

Controlling or regulating in general	G05
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C23C 16/00

Chemical coating by decomposition of gaseous compounds, without leaving reaction products of surface material in the coating, i.e. chemical vapour deposition [CVD] processes (reactive sputtering or vacuum evaporation [C23C 14/00](#))

Definition statement

This place covers:

Chemical coating by decomposition of gaseous compounds, without leaving reaction products of surface material in the coating, e.g. chemical vapour deposition (CVD), chemical coating by decomposition of gaseous compounds using electric discharge (plasma coating), using non excited gas phase coating.

- Coating material
- Chemical coating processes
- Pre-treatment of the substrate or after-treatment of the coating
- Apparatus features important to the coating method, e.g. gas inlets in CVD

References

Limiting references

This place does not cover:

Reactive sputtering or vacuum evaporation	C23C 14/00
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Informative references

Attention is drawn to the following places, which may be of interest for search:

Multilayers	C23C 28/00
Deposition of organic layers	B05D 7/00
Cleaning	B08B
Carbon (fullerenes)	C01B 32/00
Surface treatment of glass	C03C 17/00
After-treatment of ceramics	C04B 41/00
Organometallic compounds	C07F
Epitaxial layers	C30B 23/00 and C30B 25/00
Conductors or Cables	H01B 13/06
Plasma apparatuses	H01J 37/00
Semiconductors	H01L

Special rules of classification

General considerations.

CPC groups are given to well disclosed CVD coating methods.

CPC groups are further given to related methods, such as pre-treatment of the substrate or after-treatment of the coating.

CPC groups are further given to apparatus features important to the coating method, such as gas inlets in CVD.

Trivial references to well known CVD processes are not classified. As an example "...the SiO₂ layer was deposited by decomposition of TEOS in the presence of oxygen..." may be mentioned.

In this subclass, an operation is considered as pre-treatment or after-treatment when it is specially adapted for, but quite distinct from, the coating process concerned and constitutes an independent operation. If an operation results in the formation of a permanent sub-layer or upper layer, it is considered as pre-treatment or after-treatment only if it has a direct impact on the layer above or below respectively. During classification in [C23C 16/00](#) it is common that a document is vague about some of the subject-matter relating to CVD, making the classifier doubt if the document should be classified or not. The classifier should in these cases be guided by his/her own best judgement and the possible importance of the well disclosed subject-matter.

Specific considerations related to specific parts of the classification scheme.

Most of the groups in [C23C 16/00](#) are self-explanatory. Below some explanation of non obvious aspects.

[C23C 16/01](#): Any method for substrate coating separation is classified here, not only etching.

[C23C 16/0272-C23C 16/029](#): The sub-layers are classified only if they have a direct relation to the CVD coating above. Examples are improvement of the adhesion or influence on the structure or properties of the CVD coating above.

[C23C 16/04-C23C 16/047](#): Deliberately taking action to avoid coating on some areas of the substrate. Merely coating the front side of a substrate directed towards a source of coating material and not coating the side that the substrate rests on is not classified.

[C23C 16/27](#): All processes for deposition of diamond not in the subdivisions [C23C 16/271-C23C 16/279](#), in particular hybrid and combination processes.

[C23C 16/28](#): For description of the non metal elements see IPC section [C](#) one of the first pages. Here, also Ge is considered to be a non-metal as opposed to the definition in the IPC.

[C23C 16/40-C23C 16/409](#): The alkaline earth, refractory and iron group metals are defined in IPC section [C](#) on one of the first pages. Mixed oxides from different groups are classified in [C23C 16/40](#). Mixed oxides from one group is classified in that group. For example Al-Mg-O is classified in [C23C 16/403](#) but Ti-Al-O is classified in [C23C 16/40](#).

[C23C 16/44](#): Here, coating processes are classified that does not fit the groups [C23C 16/4401-C23C 16/545](#). Examples are processes based on a combinations of CVD and PVD and combinations of different CVD processes.

[C23C 16/452](#): The most important aspect of this group is the CVD process where radicals but not ions from a plasma takes part in the deposition process.

[C23C 16/453](#): These processes are only classified if a coating is made. Processes for creating "soot" for glass making are not classified here, but in [C03C](#).

[C23C 16/45525-C23C 16/45553](#): Sequentially exposing the substrate to the precursors: Reacting the first precursor with the surface of the substrate and subsequently reacting the first precursor on the surface of the substrate with the second precursor.

[C23C 16/45563-C23C 16/4588](#): These groups relate largely to apparatus features that are important for the deposition process. These features are only classified if documents discloses a relation to a CVD coating method. General documents describing apparatus features are classified in the appropriate places such as [H01L](#) and [B01J](#).

[C23C 16/46](#) vs [C23C 16/481](#): Note that [C23C 16/481](#) takes precedence.

[C23C 16/50-C23C 16/517](#): These groups relate to plasma CVD processes where in some cases apparatus features are important. These features are only classified if documents disclose a relation to a plasma CVD coating method. General document describing plasma apparatuses are classified in [H01J 37/00](#).

C23C 16/52

Controlling or regulating the coating process {([C23C 16/45557](#), [C23C 16/279](#) take precedence)}

References

Limiting references

This place does not cover:

Control of diamond crystallography	C23C 16/279
Pulsed pressure or control pressure	C23C 16/45557

Informative references

Attention is drawn to the following places, which may be of interest for search:

Controlling or regulating in general	G05
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C23C 18/00

Chemical coating by decomposition of either liquid compounds or solutions of the coating forming compounds, without leaving reaction products of surface material in the coating; Contact plating

Definition statement

This place covers:

- Chemical coating occurring through decomposition of either liquid compounds, solutions, dispersions or paste of the coating forming compounds without leaving reactions products of surface material in the coating
- Coating compositions, compounds or processes step specific to said coating
- Contact plating

References

Informative references

Attention is drawn to the following places, which may be of interest for search:

Molten material spraying, e.g. Plasma spraying	C23C 4/00
Diffusion onto metallic substrate	C23C 8/00 - C23C 12/00
Chemical surface reaction	C23C 8/00 , C23C 22/00
Vapour coating through PVD	C23C 14/00
Vapour coating through CVD	C23C 16/00
Chemical surface treatment of metallic material by reaction of the surface with a reactive liquid	C23C 22/00
Coating of inorganic material not in molten state, e.g. cold spray, heat or pressure on metallic substrate	C23C 24/00

Superposed coating from at least 2 layers on metallic substrate	C23C 28/00
Medical implants	A61L
Process of fluid deposition	B05D
Glass	C03C
Ceramics	C04B
Polymer coating composition	C09D 5/00
Ink	C09D 11/00
Electroplating	C25D
Measuring thickness	G01B
Controlling or regulating	G05B
Capacitors	H01G 9/00
Semiconductors	H01L 21/00
Solar cells	H01L 31/00
Printed circuit boards	H05K 3/00
Solution for the manufacture of photoactive layer	H10K 99/00

Special rules of classification

3 subgroups are present:

-[C23C 18/02](#)- [C23C 18/14](#): thermal decomposition through heating or irradiation

-[C23C 18/16](#)-[C23C 18/52](#): electroless deposition through use of a chemical reducing agent

-[C23C 18/54](#): electroless deposition through substitution with a more electropositive metal than the one being substituted

These sub-groups and their corresponding sub-divisions are generally self-explanatory but more details is given for the following classes:

Glossary of terms

In this place, the following terms or expressions are used with the meaning indicated:

Contact plating	Plating of metal surface with a more electropositive metal
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Synonyms and Keywords

Contact plating	displacement, immersion, cementation, exchange, dipping, replacement, substitution, "displacement replacement"
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C23C 18/02

by thermal decomposition

Definition statement

This place covers:

Processes, apparatus compositions or compounds for chemical coating by thermal decomposition.

Definition statement

Processes of chemical coating by thermal decomposition characterised by the deposition of material other than inorganic material and involving particles

Apparatus for deposition of particles in general

Process of chemical coating by thermal decomposition characterised by the deposition of metallic material including particles.

Special rules of classification

Processes of chemical coating by thermal decomposition characterised by deposition of inorganic material other than metallic material, including or not particles are classified in [C23C 18/12](#) subgroups.

C23C 18/04

Pretreatment of the material to be coated ([C23C 18/06](#) takes precedence)

References

Limiting references

This place does not cover:

Coating on selected surface areas, e.g. using masks	C23C 18/06
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C23C 18/06

Coating on selected surface areas, e.g. using masks

Definition statement

This place covers:

Coating for which a pattern area is present, e.g. using masks.

Coatings on selected areas without shielding layer present

Synonyms and Keywords

Keywords for coating on selected surfaces:	pattern, mask
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C23C 18/08

characterised by the deposition of metallic material

Definition statement

This place covers:

Coating for the deposition of metallic material per se and coating for the deposition of aluminium per se through thermal decomposition.

C23C 18/12

characterised by the deposition of inorganic material other than metallic material

Definition statement

This place covers:

processes and product thereof whereby an inorganic material is deposited through thermal decomposition of its reactant/precursor

apparatus for said process and manufacture of product

Special rules of classification

4 parts with subdivision are present within this group covering:

[C23C 18/1204-C23C 18/122](#): the composition of the product deposited.

[C23C 18/1225](#): the production of multilayers.

[C23C 18/1229-C23C 18/1245](#): the composition of the substrate onto which the inorganic coating is deposited.

[C23C 18/125-C23C 18/1295](#): the features of the process.

All 4 subdivision have equal weight: classification occurs in any or all of the 4 when features present in claims.

C23C 18/1216

{Metal oxides ([C23C 18/1212](#) takes precedence)}

Definition statement

This place covers:

Processes, compositions for chemical coating by thermal decomposition characterised by the deposition of metal oxides other than zeolites or glasses.

References

Limiting references

This place does not cover:

Coating of Zeolites, glasses	C23C 18/1212
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C23C 18/14

Decomposition by irradiation, e.g. photolysis, particle radiation {or by mixed irradiation sources}

Definition statement

This place covers:

Process for deposition of metallic or inorganic material through decomposition by irradiation.

Special rules of classification

Classification is also given to the material being deposited when known: [C23C 18/08](#), [C23C 18/12](#).

Synonyms and Keywords

In patent documents, the following words/expressions are often used as synonyms:

- "decomposition by irradiation", "photochemical deposition"

In patent documents, the word/expression in the first column is often used instead of the word/expression in the second column, which is used in the classification scheme of this place:

Radiation, irradiation, e-beam, laser, UV	[decomposition by irradiation]
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C23C 18/16

by reduction or substitution, e.g. electroless plating ([C23C 18/54](#) takes precedence)

Definition statement

This place covers:

- Electroless plating of metals or metal oxides, optionally with solid particles
- Constituent of electroless plating composition, i.e. special product not specific for a defined electroless metal composition
- Forming dispersion of solid particles in the product (composite) by electroless plating
- Electroless plating using dispersion containing solid particles

References

Limiting references

This place does not cover:

Contact plating	C23C 18/54
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Glossary of terms

In this place, the following terms or expressions are used with the meaning indicated:

Electroless plating	Process of depositing a coating with the aid of a chemical reducing agent in solution and without the application of external electrical power
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C23C 18/1601

{Process or apparatus}

Definition statement

This place covers:

- Process or apparatus for chemical coating by reduction or substitution, for example:
 - -process for deposition of material through reduction or substitution by use of a chemical reducing agent
 - -process whereby application of reducing and metal solution are separated

Synonyms and Keywords

Synonyms for process	-chemical plating/deposition/coating -non electrolytic plating/ deposition/coating-autocatalytic plating/deposition/coating
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C23C 18/1603

{coating on selected surface areas}

Definition statement

This place covers:

Coatings whereby the electroless coating is patterned.

Special rules of classification

Electroless deposition on selected surface areas by the use of mask is classified in [C23C 18/1605](#).

Synonyms and Keywords

Synonym for coating on selected surface areas	pattern
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C23C 18/1617

{Purification and regeneration of coating baths}

Definition statement

This place covers:

Process whereby the electroless coating bath is purified or regenerated.

References

Limiting references

This place does not cover:

Control of the bath/process	C23C 18/1601
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C23C 18/18

Pretreatment of the material to be coated

Definition statement

This place covers:

Pretreatment not specific to a particular substrate as well as pretreatment of metallic substrate to be coated.

Special rules of classification

- Pretreatment of inorganic substrate other than metallic substrate is classified in [C23C 18/1851](#), an operation being considered as pre-treatment when it is specially adapted for, but quite distinct from, the coating process concerned and constitutes an independent operation.
- Pretreatment of organic substrate only is classified in [C23C 18/20](#)

- - [C23C 18/2006](#) covers pretreatment which are not covered by any sub-groups [C23C 18/2013](#) - [C23C 18/30](#), e.g. gas pretreatment (ozone), corona discharge, cold plasma pretreatment.

Glossary of terms

In this place, the following terms or expressions are used with the meaning indicated:

Sensitising in C23C 18/28 and lower	pre-treatment to the activation step by activation of a reducing agent on the substrate surface for promoting the formation of metallic clusters on the substrate surface during the subsequent activation step, e.g. Sn based solution
Activating in C23C 18/28 and lower	Formation of catalytic site on the substrate surface by reduction of metal ions and deposition of metallic clusters, thereby facilitating subsequent electroless plating steps, e.g. Pd, Ag, Au, based solution

The steps of sensitising and activating are either used in a 2 step process or a 1 step process in the patent literature.

The term "sensitising" and "activating" are sometimes used interchangeably in the patent literature.

C23C 18/31

Coating with metals

Definition statement

This place covers:

Coating with metals through electroless plating process.

References

Informative references

Attention is drawn to the following places, which may be of interest for search:

Electroplating composition	C25D 3/00
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Special rules of classification

- Coating with a reducing agent containing phosphorus or boron does not equate to coating of alloy
- Coating of alloy is an alloy of at least 2 metals

C23C 18/54

Contact plating, i.e. electroless electrochemical plating

Definition statement

This place covers:

Plating of metal surface (e.g. Ni, Cu) with a more electropositive metal (e.g. noble metal).

Synonyms and Keywords

Contact plating	displacement, immersion, cementation, exchange, dipping, replacement, substitution, "displacement replacement"
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C23C 20/00

Chemical coating by decomposition of either solid compounds or suspensions of the coating forming compounds, without leaving reaction products of surface material in the coating

Special rules of classification

The groups [C23C 20/00-C23C 20/08](#) are not used. The subject matter is covered by the [C23C 18/00](#) subgroups.

C23C 22/00

Chemical surface treatment of metallic material by reaction of the surface with a reactive liquid, leaving reaction products of surface material in the coating, e.g. conversion coatings, passivation of metals

Definition statement

This place covers:

Methods, compositions and apparatus for chemical surface treatment of metallic material by reaction of the metallic surface with a reactive liquid to form conversion or passivation coatings thereon.

This group covers also suspensions containing reactive liquids and non-reactive solid particles.

Apparatus for treating metallic material to form conversion coatings thereon ([C23C 22/00](#)).

General methods or special ones for forming conversion coatings on metallic materials that do not have an appropriate subgroup ([C23C 22/00](#)).

Conversion coatings ([C23C 22/00](#) - [C23C 22/47](#)).

[C23C 22/02](#) . using non-aqueous solutions

[C23C 22/05](#) . using aqueous solutions

[C23C 22/70](#) . using melts

Passivation, oxidation coatings ([C23C 22/48](#) - [C23C 22/58](#)).

Conversion coatings characterized by the process ([C23C 22/73](#)).

Pretreatment of the material to be coated ([C23C 22/78](#)).

After-treatment ([C23C 22/82](#)).

Regeneration of the coating bath ([C23C 22/86](#)).

Relationships with other classification places

Articles characterised by special methods of manufacture are not to be classified in this group but in the appropriate places for such articles, e.g. in [F16C](#) for shafts, bearings or parts thereof.

Protective layers or coatings for specific articles are not to be classified in this group but in the appropriate places, e.g. [F01D](#), [F28F](#), [A61L](#), [B22C](#).

References

Informative references

Attention is drawn to the following places, which may be of interest for search:

Coating by hot-dipping or immersion in molten material	C23C 2/00
Coating by spraying molten materials, e.g. oxides	C23C 4/00
Diffusion coatings (chemical surface reaction)	C23C 8/00 , C23C 10/00 , C23C 12/00
PVD coatings	C23C 14/00
CVD coatings	C23C 16/00
Chemical coating by decomposition	C23C 18/00 , C23C 20/00
Sol-gel coatings	C23C 18/12
Powder coatings, e.g. by spraying molten material	C23C 24/00
Other coating methods for metallic substrates	C23C 26/00
Multilayer coatings, at least two superposed coatings either by methods not provided for in a single one of groups C23C 2/00-C23C 26/00 or by combinations of methods provided for in subclasses C23C and C25C or C25D	C23C 28/00
Coating a metal defined by the composition of the coating rather than the coating process	C23C 30/00
Coating materials for prostheses	A61L 27/28
Catalysts comprising oxides, or hydroxides of Mg, B, Al, C, Si, Ti, Zr, Hf	B01J 21/00
Protection of catalyst by coating	B01J 33/00
Process, in general, for preparing catalysts, e.g. by coating	B01J 37/02
Apparatus for depositing polymeric coatings	B05C
Process for applying monomolecular layers (SAM layers)	B05D 1/185 , G03F 7/165 , B82B
Pretreatment of surfaces to which liquids or other fluent are to be applied; After-treatment of applied coatings	B05D 3/00
Process for applying liquids or other fluent materials to obtain special surface effects, finishes or structures, e.g. for repairing damaged coatings	B05D 5/00 , B05D 5/005
Processes specially adapted for applying liquids or other fluent materials to metal surfaces, e.g. car bodies, metallic pipes or tubes; or to internal surfaces of tubes or pipes	B05D 7/14 , B05D 7/146 , B05D 7/22 , B05D 7/222
Processes for applying multilayers from a liquid; Painting	B05D 7/50
One specific pretreatment, e.g. phosphatation, chromatisation, and one specific coating	B05D 7/51
Coatings for surface of moulds, cores or pattern	B22C 3/00
Preliminary treatment of areas to be soldered	B23K 1/20
Non-corrosive coatings; primers applied before welding	B23K 35/226
Non-metallic compositions, e.g. coatings of interest in soldering or welding	B23K 35/36
Bonding rubber to metal (mechanical)	B29C 66/742
Laminates, self-supporting layers	B32B 15/00

Informative references

Chemical or electrical treatment of printing surfaces with a chromium compound, a silicon compound, a phosphorous compound or a compound of a metal group IVB	B41N 3/038
Coating containing alkyl silicates or metals silicates	C04B 28/24
Coating containing alkali metals silicates	C04B 28/26
Coatings containing phosphates binders	C04B 28/34
Bonding rubber or polymer to a metal (chemical)	C08J 5/00
Coatings with alkali metal silicates	C09D 1/04
Coatings with siloxanes	C09D 4/00 , C08G 77/00
Corrosion-inhibiting coatings (anti-corrosive paints, anti-corrosion oils) for metallic material	C09D 5/08
Wash primers	C09D 5/12
Coatings based on homopolymers or copolymers having one or more unsaturated aliphatic radicals	C09D 133/00
Coatings with polyesters	C09D 167/00
Coating with polyamines	C09D 179/00
Coatings with polysilicates, polysiloxanes	C09D 183/00
Adhesive bonding involving pretreatment of the surface to be joined	C09J 5/00 , C09J 5/02
Lubricating composition containing more than 10 % water and not containing mineral or fatty oils	C10M 173/02
Local protective coating	C21D 1/72
Chemical treatment of the metal surfaces prior to coating by enamelling, or by applying a vitreous layer to metals	C23D 3/00
Enamelling of, or applying a vitreous layer to, metals	C23D 5/00
Pretreatment of metallic material, by etching	C23F 1/00
Corrosion inhibitors	C23F 11/00
Pretreatment of metallic material, by cleaning/pickling	C23G 1/00 , C23G 5/00
Electrolytic recovery	C25C 1/00
Electrolytic coating	C25D 3/00 , C25D 5/00 , C25D 7/00
Electrochemical coating with inorganic materials	C25D 9/04
Electrochemical Phosphatising	C25D 11/36
Electrochemical Chromatising	C25D 11/38
Particular treatment of turbine blades	F01D 5/286
Protective coatings for turbine blades	F01D 5/288 , F05C 2253/12
Protective coatings for heat exchangers	F28F 19/02
Corrosion protection, e.g. by coating of magnetic steels	H01F 27/23
Applying non-metallic protective coatings	H05K 3/28
Improving adhesion between the insulating substrate and the metal by conversion of the metal surface, e.g. by oxidation	H05K 3/385
Improving adhesion between the insulating substrate and the metal by the use of a coupling agent, e.g. silane	H05K 3/389

Special rules of classification

In this group it is MANDATORY to classify ALL EXAMPLES of Compositions or Methods.

Other well-disclosed and non-trivial aspects are also classified.

Rejuvenating of the bath is classified in the appropriate place for the specific bath composition.

[C23C 22/24](#) - [C23C 22/33](#), [C23C 22/04](#), [C23C 22/37](#), [C23C 22/38](#), [C23C 22/43](#), [C23C 22/67](#) - treatment with acidic aqueous solutions containing hexavalent chromium compounds - an old technology being phased out due to the carcinogenic effects of hexavalent chromium compounds (see, Restriction of Hazardous Substances (RoHS) - European Union Directive 2002/95/EC).

Classification of additional information

In many cases the classification of additional information is very useful for retrieving the document, and therefore very desirable, although not compulsory. Well-known (trivial) aspects or features are not classified.

For example:

If a document discloses a "conversion process and composition for treatment of aluminium" ([C23C 22/56](#)), which in the description is also described as being suitable "for treating magnesium", and if this additional information is per se new /inventive ("non-trivial"), it is classified, namely [C23C 22/57](#) as well.

In some cases the additional information is broadly defined as any secondary information useful for search that is not relevant per se, but that could be interesting for search when considered together with the important (invention-like) information, then it is classified with (Indexing Code), e.g. [C23C 2222/10](#) for searching conversion coatings based on Cr(III) with no Cr(VI), [C23C 2222/20](#) for searching conversion coatings containing or corrosion inhibiting compositions based on silanes or hydrolysis or condensation products thereof.

It is mandatory to classify additional information concerning conversion coating compositions based on Cr(III) in [C23C 2222/10](#). It is mandatory to classify additional information concerning conversion coating compositions based on silanes or hydrolysis or condensation products in [C23C 2222/20](#).

Subgroups and head group

In the head group [C23C 22/00](#), the specific technical information is relevant to the apparatus for treating metallic material to form conversion coatings thereon; and the general methods or special ones for forming conversion coatings on metallic materials that do not have an appropriate subgroup.

In subgroups [C23C 22/02](#) - [C23C 22/86](#), in the absence of an indication to the contrary, classification is made in the last appropriate place.

In the subgroup [C23C 22/17](#) the specific technical information is relevant to the chemical treatment of metallic material with acidic aqueous phosphating solutions which, besides zinc ions, oxidants (nitrite, nitrate, chlorate), contains organic acids, or hydroxylamines, or nitrocompounds, such as nitrobenzene sulfonate.

In the subgroup [C23C 22/73](#) the specific technical information is relevant to the process, e.g. two consecutive treatments or the way how the coating is applied to metallic surfaces.

In the subgroup [C23C 22/74](#) the specific technical information is relevant to the process of conversion coatings formed by chemical reactions of concentrated reactive solutions followed by a thermal treatment (curing step) at temperatures more than 100 - 120 °C.

In the subgroup [C23C 22/84](#) the specific technical information is relevant to the after-treatment (post-treatment) of conversion or passivation coatings by dyeing (coloration). If the conversion or passivation coating is coloured, no classification in [C23C 22/84](#).

Glossary of terms

In this place, the following terms or expressions are used with the meaning indicated:

Metallic material	covers metals and alloys (attention is drawn to the Note following the title of subclass C22C).
Phosphate coatings	Phosphate coatings are processes of chemical conversion on a metal surface to produce thin adherent phosphate compound coatings. The phosphate crystals formed on the surfaces of materials can be iron, zinc, or manganese phosphates. Among these phosphates, manganese phosphate is more suitable for wear applications. Phosphate coatings are usually applied to carbon steel, low-alloy steel, and cast iron. They can also be applied to zinc, cadmium, aluminum, and tin. Phosphate processes are hard to apply on high alloys for these alloys are likely immune to the phosphoric acid. In short, phosphating is one of the most useful non-metallic conversion coatings.
Chromate coatings	Chromate coatings, similar to phosphate coatings, are processes of chemical conversion. But the chromate coatings are formed by the reaction of water solutions of chromic acid or chromium salts. The coatings can be applied to aluminum, zinc, cadmium, and magnesium. The coatings usually have good atmospheric corrosion resistance. Chromate coatings are widely used in protecting common household products, such as screws, hinges, and many hardware items with the yellow-brown appearance.
Oxide coatings	The oxide coatings are in fact corrosion products which is a thin, usually less than 2.5 μm oxide with good adhesion. The oxide treatments are done by heat, chemicals, or electrochemical reactions.
Bluing-type oxidations	gun -bluing -type oxidations are done by heating the metals, generally steel, at 370°C in a steam atmosphere. Chemical baths produce coatings similar to a gun bluing coating by immersion techniques.
Black oxide or blackening coatings	Black oxide or blackening coatings is a conversion coating for steel, copper, zinc, powder metals and silver solder, and most for stainless steel by treating with hot caustic soda (blackening agent). Some pastes can be rubbed on surfaces to produce similar results.

Synonyms and Keywords

In patent documents, the following abbreviations are often used:

Passivation	oxidation, bluing
Conversion	phosphating or phosphatation, chromating or chromatation black oxide or blackeningcerium oxide conversion coatings
Anodizing or anodising	electrochemical conversion coating
Burned-in	cured
Condensed phosphates	polyphosphates
Dyeing	postcoloration of the conversion or passivation coating

C23C 22/77

Controlling or regulating of the coating process

References

Informative references

Attention is drawn to the following places, which may be of interest for search:

Controlling or regulating in general	G05
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C23C 24/00

Coating starting from inorganic powder (spraying of the coating material in molten state [C23C 4/00](#); solid state diffusion [C23C 8/00](#) - [C23C 12/00](#))

Definition statement

This place covers:

Coating methods where the material to be coated is applied in powder form on the surface of the substrate to be coated, e.g. cold spray methods.

Also methods where the coating material is applied in form of a slurry as long as said methods result in obtaining a coating, and not in a modification of the surface of the substrate or in a diffusion into the substrate.

References

Limiting references

This place does not cover:

Spraying of the coating material in molten state, starting from a powder	C23C 4/00
Solid state diffusion of only non-metal elements into metallic material surfaces	C23C 8/00
Solid state diffusion of only non-metal elements into metallic material surfaces using solids, e.g. powders, pastes	C23C 8/60 - C23C 8/78
Solid state diffusion of only metal elements or silicon into metallic material surfaces using solids, e.g. powders, pastes	C23C 10/28 - C23C 10/58
Solid state diffusion of at least one non-metal element other than silicon and at least one metal element or silicon into metallic material surfaces	C23C 12/00
Manufacture of composite layers, workpieces or articles by sintering metallic powder	B22F 7/00
Friction welding	B23K 20/12
Coating mortars, concrete, artificial stone or ceramics, using a powder as coating material	C04B 41/4545 - C04B 41/4549
Coating mortars, concrete, artificial stone or ceramics, with vitreous materials	C04B 41/5022

Informative references

Attention is drawn to the following places, which may be of interest for search:

Enamelling of, or applying a non refractory vitreous layer to, metals	C23D 5/00 - C23D 5/08
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Glossary of terms

In this place, the following terms or expressions are used with the meaning indicated:

Metallic material	Metals or metal alloys, optionally comprising hard particles, e.g. oxides, carbides or nitrides
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C23C 24/04

Impact or kinetic deposition of particles

Definition statement

This place covers:

Cold spray methods, i.e. spraying methods in which the sprayed particles are not significantly melted before reaching the substrate.

References

Limiting references

This place does not cover:

Spraying of the coating material in molten state, starting from a powder	C23C 4/00
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C23C 26/00

Coating not provided for in groups [C23C 2/00](#) - [C23C 24/00](#)

Definition statement

This place covers:

Any method of coating a metallic surface and/or of coating a substrate with a metallic material which is not already described in any of groups [C23C 2/00](#) - [C23C 24/00](#)

References

Limiting references

This place does not cover:

Applying liquids or other fluent materials to surfaces in general	B05
Making metal-coated products by extrusion	B21C 23/22
Connecting objects or parts, e.g. coating with sheet metal otherwise than plating	B21D 39/00
Working of metal by the action of a high concentration of electric current on a workpiece using an electrode	B23H
Plating by soldering or welding	B23K
Metallising of glass	C03C 17/36
Metallising mortars, concrete, artificial stone, ceramics or natural stone	C04B 41/00
Paints, varnishes, lacquers	C09D
Enamelling of, or applying a vitreous layer to, metals	C23D 5/00
Treating metal surfaces or coating of metals by electrolysis or electrophoresis	C25D

Electrolytic stripping of metallic layers or coatings	C25F 5/00
Single-crystal film growth	C30B
Manufacture of semiconductor devices	H01L
Manufacture of printed circuits	H05K

C23C 26/02

applying molten material to the substrate

Definition statement

This place covers:

Any method of coating a metallic surface with a molten material or molten metallic material to a substrate which is not already described in any of groups [C23C 2/00](#) - [C23C 24/00](#), e.g. brazing, arc welding, laser welding, friction welding, laser alloying

C23C 28/00

Coating for obtaining at least two superposed coatings either by methods not provided for in a single one of groups [C23C 2/00](#) - [C23C 26/00](#) or by combinations of methods provided for in subclasses [C23C](#) and [C25C](#) or [C25D](#)

Definition statement

This place covers:

Multi-layered coatings, where the different layers composing the coating have been deposited by at least two different methods as disclosed in group [C23C 2/00](#) - [C23C 26/00](#) or by a combination of one method from [C23C](#) and one method from [C25D](#).

Relationships with other classification places

Articles characterised by special methods of manufacture are not to be classified in this group but in the appropriate places for such articles, e.g. optical coatings of optical elements [G02B 1/10](#), magnetic record carriers [G11B 5/00](#), resistors [H01C 7/00](#), capacitors [H01G 4/00](#), semiconductor and/or solid-state devices [H01L](#), batteries and/or fuel cells [H01M](#), semiconductor lasers [H01S 5/00](#) and so on.

If a multilayered product classified in [B32B](#) is obtained by at least two different methods as disclosed in groups [C23C 2/00](#) - [C23C 26/00](#) or by a combination of methods provided for in subclasses [C23C](#) and [C25](#), then the combination of methods should be classified in [C23C 28/00](#) subgroups.

References

Limiting references

This place does not cover:

Deposition of sublayers, e.g. to promote adhesion of the coating, prior to the deposition of a coating by PVD	C23C 14/024 - C23C 14/025
Deposition of sublayers, e.g. to promote adhesion of the coating, prior to the deposition of a coating by CVD	C23C 16/0272 - C23C 16/029

Special rules of classification

- Classes are given to well disclosed coatings. Classes are given for all and every aspects/features present in the multi-layered coating being classified, in order to enable an easy cross-searching.

- Multi-layered coatings where all layers are made of a metallic material, as defined in the glossary above, are classified in [C23C 28/02](#) and subgroups.
- Multi-layered coatings where all layers are made of an inorganic non-metallic material, as defined in the glossary above, are classified in [C23C 28/04](#) and subgroups.
- Multi-layered coatings comprising a mixture of metallic and non-metallic layers as defined in the glossary above, are classified in **C23C28/06** and subgroups.
- Multi-layered coatings comprising alternating layers following a pattern and/or a periodic or defined repetition are classified additionally in **C23C28/08** and subgroups.
- Coatings characterized by a main coating and an adhesion (sub)-layer are not to be classified in [C23C 28/00](#), even if said adhesion layer is deposited using a different method as the method used for the main coating, but according to the method used for the main coating, e.g. for a PVD method in [C23C 14/024](#), for a CVD method in [C23C 16/0272](#).
- Multi-layered coatings that cannot be classified in any one of the single groups [C23C 28/02](#), [C23C 28/04](#) or **C23C28/06** and their subgroups, but still fall within the definition statement of the main group are to be classified in [C23C 28/00](#).

Glossary of terms

In this place, the following terms or expressions are used with the meaning indicated:

Metallic material	Metals and metals alloys, not including inorganic materials such as oxides, carbides, nitrides, borides, silicides and their mixtures, with the exception where said inorganic materials are embedded in a metal matrix as hard particles, e.g. Cermets and MMC.
Inorganic non-metallic materials	Oxides, carbides, nitrides, borides, silicides and their mixtures, enamels, phosphates and sulphides.

C23C 30/00

Coating with metallic material characterised only by the composition of the metallic material, i.e. not characterised by the coating process ([C23C 26/00](#), [C23C 28/00](#) take precedence)

Definition statement

This place covers:

Coatings obtained by any of the methods of group [C23C 2/00](#) - [C23C 26/00](#) but characterized either by the peculiarity of their compositions or of their structures, e.g. columnar thermal barrier coatings, metal matrix composite coatings, two/multi-phase metallic coatings, quasicrystalline coatings, etc.

C23C 30/005

{on hard metal substrates}

Definition statement

This place covers:

Essentially coated cutting tools where the coating has been obtained by any of the methods of group [C23C 2/00](#) - [C23C 26/00](#) .

Relationships with other classification places

Cutting tools of which the bits, tips or cutting inserts are of a special material are per se classified in [B23B 27/14](#) and not systematically cross-classified in [C23C 30/005](#) when said special material includes a coating.

Relationships with other classification places

Cutting tools coated with multi-layered coatings should also be classified in [C23C 28/00](#), when said multi-layered coatings are of a particular interest.

Glossary of terms

In this place, the following terms or expressions are used with the meaning indicated:

Hard metal substrates	Includes cemented carbide substrates
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