

CPC COOPERATIVE PATENT CLASSIFICATION

C CHEMISTRY; METALLURGY

(NOTES omitted)

METALLURGY

C23 COATING METALLIC MATERIAL; COATING MATERIAL WITH METALLIC MATERIAL; CHEMICAL SURFACE TREATMENT; DIFFUSION TREATMENT OF METALLIC MATERIAL; COATING BY VACUUM EVAPORATION, BY SPUTTERING, BY ION IMPLANTATION OR BY CHEMICAL VAPOUR DEPOSITION, IN GENERAL; INHIBITING CORROSION OF METALLIC MATERIAL OR INCRUSTATION IN GENERAL

(NOTES omitted)

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](#))

NOTE

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- or upper layer, it is not considered as pre-treatment or after-treatment and is classified as a multi-coating process.

WARNING

The following IPC groups are not in the CPC scheme. The subject matter for these IPC groups is classified in the following CPC groups:

[C23C 14/36](#) - [C23C 14/44](#)

covered by

[C23C 14/34](#) - [C23C 14/358](#)

Coating by applying the coating material in the molten state
(casting [B22D](#), e.g. [B22D 19/08](#), [B22D 23/04](#), [B29](#); built-up welding [B23K](#), e.g. [B23K 5/18](#), [B23K 9/04](#))

- 2/00 Hot-dipping or immersion processes for applying the coating material in the molten state without affecting the shape; Apparatus therefor**
- 2/003 . {Apparatus, e.g. crucibles, heating devices}
- 2/006 . {Pattern or selective deposit without pre-treatment of the material to be coated}
- 2/02 . Pretreatment of the material to be coated, e.g. for coating on selected surface areas ([C23C 2/30](#) takes precedence)
- 2/04 . characterised by the coating material
- 2/06 . . Zinc or cadmium or alloys based thereon
- 2/08 . . Tin or alloys based thereon
- 2/10 . . Lead or alloys based thereon
- 2/12 . . Aluminium or alloys based thereon

- 2/14 . Removing excess of molten coatings; Controlling or regulating the coating thickness
- 2/16 . . using fluids under pressure, e.g. air knives
- 2/18 . . . Removing excess of molten coatings from elongated material
- 2/185 {Tubes; Wires}
- 2/20 Strips; Plates
- 2/22 . . by rubbing, e.g. using knives {, e.g. rubbing solids}
- 2/24 . . using magnetic or electric fields
- 2/26 . After-treatment ([C23C 2/14](#) takes precedence)
- 2/265 . . {by applying solid particles to the molten coating}
- 2/28 . . Thermal aftertreatment, e.g. treatment in oil bath
- 2/285 . . . {for remelting the coating}
- 2/30 . Fluxes or coverings on molten baths ([C23C 2/22](#) takes precedence)

- 2/32 using vibratory energy applied to the bath or substrate ([C23C 2/14 takes precedence](#))
- 2/34 . . characterised by the shape of the material to be treated ([C23C 2/14 takes precedence](#))
- 2/36 . . . Elongated material
- 2/38 Wires; Tubes
- 2/385 {Tubes of specific length}
- 2/40 Plates; Strips
- 2/405 {Plates of specific length}
- 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](#))**
- 4/01 . . Selective coating, e.g. pattern coating, without pre-treatment of the material to be coated
- 4/02 . . Pretreatment of the material to be coated, e.g. for coating on selected surface areas
- 4/04 . . characterised by the coating material
- 4/06 . . . Metallic material
- 4/067 . . . containing free particles of non-metal elements, e.g. carbon, silicon, boron, phosphorus or arsenic
- 4/073 . . . containing MCrAl or MCrAlY alloys, where M is nickel, cobalt or iron, with or without non-metal elements
- 4/08 . . . containing only metal elements ([C23C 4/073 takes precedence](#))
- 4/10 . . Oxides, borides, carbides, nitrides or silicides; Mixtures thereof
- 4/11 . . . Oxides
- 4/12 . . characterised by the method of spraying
- 4/123 . . . Spraying molten metal
- 4/126 . . . Detonation spraying
- 4/129 . . . Flame spraying
- 4/131 . . . Wire arc spraying
- 4/134 . . . Plasma spraying
- 4/137 . . . Spraying in vacuum or in an inert atmosphere
- 4/14 . . . for coating elongate material
- 4/16 Wires; Tubes
- 4/18 . . . After-treatment
- 4/185 . . . {Separation of the coating from the substrate}
- 6/00 Coating by casting molten material on the substrate**
- Solid state diffusion into metallic material surfaces**
- 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](#))**
- 8/02 . . Pretreatment of the material to be coated ([C23C 8/04 takes precedence](#))
- 8/04 . . Treatment of selected surface areas, e.g. using masks
- 8/06 . . using gases ([C23C 8/36 takes precedence](#))
- 8/08 . . . only one element being applied
- 8/10 Oxidising
- 8/12 using elemental oxygen or ozone
- 8/14 Oxidising of ferrous surfaces
- 8/16 using oxygen-containing compounds, e.g. water, carbon dioxide
- 8/18 Oxidising of ferrous surfaces
- 8/20 Carburising
- 8/22 of ferrous surfaces
- 8/24 Nitriding
- 8/26 of ferrous surfaces
- 8/28 . . . more than one element being applied in one step
- 8/30 Carbo-nitriding
- 8/32 of ferrous surfaces
- 8/34 . . . more than one element being applied in more than one step
- 8/36 . . . using ionised gases, e.g. ionitriding
- 8/38 Treatment of ferrous surfaces
- 8/40 . . using liquids, e.g. salt baths, liquid suspensions
- 8/42 . . . only one element being applied
- 8/44 Carburising
- 8/46 of ferrous surfaces
- 8/48 Nitriding
- 8/50 of ferrous surfaces
- 8/52 . . . more than one element being applied in one step
- 8/54 Carbo-nitriding
- 8/56 of ferrous surfaces
- 8/58 . . . more than one element being applied in more than one step
- 8/60 . . using solids, e.g. powders, pastes ([using liquid suspensions of solids C23C 8/40](#))
- 8/62 . . . only one element being applied
- 8/64 Carburising
- 8/66 of ferrous surfaces
- 8/68 Boronising
- 8/70 of ferrous surfaces
- 8/72 . . . more than one element being applied in one step
- 8/74 Carbo-nitriding
- 8/76 of ferrous surfaces
- 8/78 . . . more than one element being applied in more than one step
- 8/80 . . After-treatment
- 10/00 Solid state diffusion of only metal elements or silicon into metallic material surfaces**
- 10/02 . . Pretreatment of the material to be coated ([C23C 10/04 takes precedence](#))
- 10/04 . . Diffusion into selected surface areas, e.g. using masks
- 10/06 . . using gases
- 10/08 . . . only one element being diffused
- 10/10 Chromising
- 10/12 of ferrous surfaces
- 10/14 . . . more than one element being diffused in one step
- 10/16 . . . more than one element being diffused in more than one step
- 10/18 . . using liquids, e.g. salt baths, liquid suspensions
- 10/20 . . . only one element being diffused
- 10/22 Metal melt containing the element to be diffused
- 10/24 Salt bath containing the element to be diffused
- 10/26 . . . more than one element being diffused
- 10/28 . . using solids, e.g. powders, pastes
- 10/30 . . . using a layer of powder or paste on the surface ([using liquid suspensions of solids C23C 10/18](#))
- 10/32 Chromising

- 10/34 . . Embedding in a powder mixture, i.e. pack cementation
- 10/36 . . . only one element being diffused
- 10/38 Chromising
- 10/40 of ferrous surfaces
- 10/42 in the presence of volatile transport additives, e.g. halogenated substances
- 10/44 Siliconising
- 10/46 of ferrous surfaces
- 10/48 Aluminising
- 10/50 of ferrous surfaces
- 10/52 . . . more than one element being diffused in one step
- 10/54 Diffusion of at least chromium
- 10/56 and at least aluminium
- 10/58 . . . more than one element being diffused in more than one step
- 10/60 . After-treatment
- 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**
- 12/02 . Diffusion in one step

Coating by vacuum evaporation, by sputtering or by ion implantation

- 14/00 Coating by vacuum evaporation, by sputtering or by ion implantation of the coating forming material**
- 14/0005 . {Separation of the coating from the substrate}
- 14/001 . {Coating on a liquid substrate}
- 14/0015 . {characterized by the colour of the layer}
- 14/0021 . {Reactive sputtering or evaporation}
- 14/0026 . . {Activation or excitation of reactive gases outside the coating chamber}
- 14/0031 . . . {Bombardment of substrates by reactive ion beams}
- 14/0036 . . {Reactive sputtering}
- 14/0042 . . . {Controlling partial pressure or flow rate of reactive or inert gases with feedback of measurements}
- 14/0047 . . . {Activation or excitation of reactive gases outside the coating chamber}
- 14/0052 {Bombardment of substrates by reactive ion beams}
- 14/0057 . . . {using reactive gases other than O₂, H₂O, N₂, NH₃ or CH₄}
- 14/0063 . . . {characterised by means for introducing or removing gases}
- 14/0068 . . . {characterised by means for confinement of gases or sputtered material, e.g. screens, baffles}
- 14/0073 . . . {by exposing the substrates to reactive gases intermittently}
- 14/0078 {by moving the substrates between spatially separate sputtering and reaction stations}
- 14/0084 . . . {Producing gradient compositions}
- 14/0089 . . . {in metallic mode}
- 14/0094 . . . {in transition mode}
- 14/02 . Pretreatment of the material to be coated ([C23C 14/04](#) takes precedence)
- 14/021 . . {Cleaning or etching treatments}

- 14/022 . . . {by means of bombardment with energetic particles or radiation}
- 14/024 . . {Deposition of sublayers, e.g. to promote adhesion of the coating ([C23C 14/027](#) takes precedence)}
- 14/025 . . . {Metallic sublayers}
- 14/027 . . {Graded interfaces}
- 14/028 . . {Physical treatment to alter the texture of the substrate surface, e.g. grinding, polishing}
- 14/04 . Coating on selected surface areas, e.g. using masks
- 14/042 . . {using masks}
- 14/044 . . . {using masks to redistribute rather than totally prevent coating, e.g. producing thickness gradient}
- 14/046 . . {Coating cavities or hollow spaces, e.g. interior of tubes; Infiltration of porous substrates}
- 14/048 . . {using irradiation by energy or particles}
- 14/06 . characterised by the coating material ([C23C 14/0021](#)), [C23C 14/04](#) take precedence)
- 14/0605 . . {Carbon}
- 14/0611 . . . {Diamond}
- 14/0617 . . {AIII BV compounds, where A is Al, Ga, In or Tl and B is N, P, As, Sb or Bi}
- 14/0623 . . {Sulfides, selenides or tellurides}
- 14/0629 . . . {of zinc, cadmium or mercury}
- 14/0635 . . {Carbides}
- 14/0641 . . {Nitrides ([C23C 14/0617](#) takes precedence)}
- 14/0647 . . . {Boron nitride}
- 14/0652 . . . {Silicon nitride}
- 14/0658 . . . {Carbon nitride}
- 14/0664 . . {Carbonitrides}
- 14/067 . . {Borides}
- 14/0676 . . {Oxynitrides}
- 14/0682 . . {Silicides}
- 14/0688 . . {Cermets, e.g. mixtures of metal and one or more of carbides, nitrides, oxides or borides}
- 14/0694 . . {Halides}
- 14/08 . . Oxides ([C23C 14/10](#) takes precedence)
- 14/081 . . . {of aluminium, magnesium or beryllium}
- 14/082 . . . {of alkaline earth metals}
- 14/083 . . . {of refractory metals or yttrium}
- 14/085 . . . {of iron group metals}
- 14/086 . . . {of zinc, germanium, cadmium, indium, tin, thallium or bismuth}
- 14/087 . . . {of copper or solid solutions thereof}
- 14/088 . . . {of the type ABO₃ with A representing alkali, alkaline earth metal or Pb and B representing a refractory or rare earth metal}
- 14/10 . . Glass or silica
- 14/12 . . Organic material
- 14/14 . . Metallic material, boron or silicon
- 14/16 . . . on metallic substrates or on substrates of boron or silicon
- 14/165 {by cathodic sputtering}
- 14/18 . . . on other inorganic substrates
- 14/185 {by cathodic sputtering}
- 14/20 . . . on organic substrates
- 14/205 {by cathodic sputtering}
- 14/22 . characterised by the process of coating
- 14/221 . . {Ion beam deposition ([C23C 14/46](#), [C23C 14/48](#) take precedence)}
- 14/223 . . {specially adapted for coating particles}

- 14/225 . . {Oblique incidence of vaporised material on substrate}
 - 14/226 . . . {in order to form films with columnar structure}
 - 14/228 . . {Gas flow assisted PVD deposition}
 - 14/24 . . Vacuum evaporation
 - 14/243 . . . {Crucibles for source material ([C23C 14/28](#), [C23C 14/30](#) take precedence)}
 - 14/246 . . . {Replenishment of source material}
 - 14/26 . . . by resistance or inductive heating of the source
 - 14/28 . . . by wave energy or particle radiation ([C23C 14/32](#) - [C23C 14/48](#) take precedence)
 - 14/30 by electron bombardment
 - 14/32 . . . by explosion; by evaporation and subsequent ionisation of the vapours {, e.g. ion-plating} ([C23C 14/34](#) - [C23C 14/48](#) take precedence)
 - 14/325 {Electric arc evaporation}
 - 14/34 . . Sputtering
 - 14/3407 . . . {Cathode assembly for sputtering apparatus, e.g. Target}
 - 14/3414 {Metallurgical or chemical aspects of target preparation, e.g. casting, powder metallurgy}
 - 14/3421 {using heated targets}
 - 14/3428 {using liquid targets}
 - 14/3435 . . . {Applying energy to the substrate during sputtering}
 - 14/3442 {using an ion beam}
 - 14/345 {using substrate bias}
 - 14/3457 . . . {using other particles than noble gas ions ([C23C 14/0036](#), [C23C 14/46](#) take precedence)}
 - 14/3464 . . . {using more than one target ([C23C 14/56](#) takes precedence)}
 - 14/3471 . . . {Introduction of auxiliary energy into the plasma}
 - 14/3478 {using electrons, e.g. triode sputtering}
 - 14/3485 . . . {using pulsed power to the target}
 - 14/3492 . . . {Variation of parameters during sputtering}
 - 14/35 . . . by application of a magnetic field, e.g. magnetron sputtering {([C23C 14/3457](#) takes precedence)}
 - 14/351 {using a magnetic field in close vicinity to the substrate}
 - 14/352 {using more than one target ([C23C 14/56](#) takes precedence)}
 - 14/354 {Introduction of auxiliary energy into the plasma}
 - 14/355 {using electrons, e.g. triode sputtering}
 - 14/357 {Microwaves, e.g. electron cyclotron resonance enhanced sputtering}
 - 14/358 {Inductive energy}
 - 14/46 . . . by ion beam produced by an external ion source
 - 14/48 . . Ion implantation
 - 14/50 . . Substrate holders
 - 14/505 . . . {for rotation of the substrates}
 - 14/52 . . Means for observation of the coating process
 - 14/54 . . Controlling or regulating the coating process
 - 14/541 . . . {Heating or cooling of the substrates}
 - 14/542 . . . {Controlling the film thickness or evaporation rate}
 - 14/543 {using measurement on the vapor source}
 - 14/544 {using measurement in the gas phase}
 - 14/545 {using measurement on deposited material}
 - 14/546 {using crystal oscillators}
 - 14/547 {using optical methods}
 - 14/548 . . . {Controlling the composition}
 - 14/56 . . Apparatus specially adapted for continuous coating; Arrangements for maintaining the vacuum, e.g. vacuum locks
 - 14/562 . . . {for coating elongated substrates}
 - 14/564 . . . {Means for minimising impurities in the coating chamber such as dust, moisture, residual gases}
 - 14/566 {using a load-lock chamber}
 - 14/568 . . . {Transferring the substrates through a series of coating stations ([C23C 14/562](#) takes precedence)}
 - 14/58 . . After-treatment
 - 14/5806 . . {Thermal treatment}
 - 14/5813 . . . {using lasers}
 - 14/582 . . . {using electron bombardment}
 - 14/5826 . . {Treatment with charged particles ([C23C 14/582](#) takes precedence)}
 - 14/5833 . . . {Ion beam bombardment}
 - 14/584 . . {Non-reactive treatment}
 - 14/5846 . . {Reactive treatment}
 - 14/5853 . . . {Oxidation}
 - 14/586 . . . {Nitriding}
 - 14/5866 . . . {Treatment with sulfur, selenium or tellurium}
 - 14/5873 . . {Removal of material}
 - 14/588 . . . {by mechanical treatment}
 - 14/5886 . . {Mechanical treatment (involving removal of material [C23C 14/588](#))}
 - 14/5893 . . {Mixing of deposited material}
- Chemical deposition or plating by decomposition; Contact plating**
(solid state diffusion [C23C 8/00](#) - [C23C 12/00](#))
- 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](#))
 - 16/003 . . {Coating on a liquid substrate}
 - 16/006 . . {characterized by the colour of the layer}
 - 16/01 . . on temporary substrates, e.g. substrates subsequently removed by etching
 - 16/02 . . Pretreatment of the material to be coated ([C23C 16/04](#) takes precedence)
 - 16/0209 . . {by heating}
 - 16/0218 . . . {in a reactive atmosphere ([C23C 16/0227](#) takes precedence)}
 - 16/0227 . . {by cleaning or etching}
 - 16/0236 . . . {by etching with a reactive gas}
 - 16/0245 . . . {by etching with a plasma}
 - 16/0254 . . {Physical treatment to alter the texture of the surface, e.g. scratching or polishing}
 - 16/0263 . . . {Irradiation with laser or particle beam}
 - 16/0272 . . {Deposition of sub-layers, e.g. to promote the adhesion of the main coating}
 - 16/0281 . . . {of metallic sub-layers ([C23C 16/029](#) takes precedence)}
 - 16/029 . . . {Graded interfaces}
 - 16/04 . . Coating on selected surface areas, e.g. using masks
 - 16/042 . . {using masks}

- 16/045 . . {Coating cavities or hollow spaces, e.g. interior of tubes; Infiltration of porous substrates}
- 16/047 . . {using irradiation by energy or particles}
- 16/06 . characterised by the deposition of metallic material
- 16/08 . . from metal halides
- 16/10 . . . Deposition of chromium only
- 16/12 . . . Deposition of aluminium only
- 16/14 . . . Deposition of only one other metal element
- 16/16 . . from metal carbonyl compounds
- 16/18 . . from metallo-organic compounds
- 16/20 . . . Deposition of aluminium only
- 16/22 . characterised by the deposition of inorganic material, other than metallic material
- 16/24 . . Deposition of silicon only
- 16/26 . . Deposition of carbon only
- 16/27 . . . Diamond only
- 16/271 {using hot filaments}
- 16/272 {using DC, AC or RF discharges}
- 16/274 {using microwave discharges}
- 16/275 {using combustion torches}
- 16/276 {using plasma jets}
- 16/277 {using other elements in the gas phase besides carbon and hydrogen; using other elements besides carbon, hydrogen and oxygen in case of use of combustion torches; using other elements besides carbon, hydrogen and inert gas in case of use of plasma jets}
- 16/278 {doping or introduction of a secondary phase in the diamond}
- 16/279 {control of diamond crystallography}
- 16/28 . . Deposition of only one other non-metal element
- 16/30 . . Deposition of compounds, mixtures or solid solutions, e.g. borides, carbides, nitrides
- 16/301 . . . {AIII BV compounds, where A is Al, Ga, In or Tl and B is N, P, As, Sb or Bi}
- 16/303 {Nitrides}
- 16/305 . . . {Sulfides, selenides, or tellurides}
- 16/306 {AII BVI compounds, where A is Zn, Cd or Hg and B is S, Se or Te}
- 16/308 . . . {Oxynitrides}
- 16/32 . . . Carbides
- 16/325 {Silicon carbide}
- 16/34 . . . Nitrides {[\(C23C 16/303 takes precedence\)](#)}
- 16/342 {Boron nitride}
- 16/345 {Silicon nitride}
- 16/347 {Carbon nitride}
- 16/36 . . . Carbonitrides
- 16/38 . . . Borides
- 16/40 . . . Oxides
- 16/401 {containing silicon}
- 16/402 {Silicon dioxide}
- 16/403 {of aluminium, magnesium or beryllium}
- 16/404 {of alkaline earth metals}
- 16/405 {of refractory metals or yttrium}
- 16/406 {of iron group metals}
- 16/407 {of zinc, germanium, cadmium, indium, tin, thallium or bismuth}
- 16/408 {of copper or solid solutions thereof}
- 16/409 {of the type ABO₃ with A representing alkali, alkaline earth metal or lead and B representing a refractory metal, nickel, scandium or a lanthanide}
- 16/42 . . . Silicides
- 16/44 . characterised by the method of coating [\(C23C 16/04 takes precedence\)](#)
- 16/4401 . . {Means for minimising impurities, e.g. dust, moisture or residual gas, in the reaction chamber}
- 16/4402 . . . {Reduction of impurities in the source gas}
- 16/4404 . . . {Coatings or surface treatment on the inside of the reaction chamber or on parts thereof}
- 16/4405 . . . {Cleaning of reactor or parts inside the reactor by using reactive gases}
- 16/4407 . . . {Cleaning of reactor or reactor parts by using wet or mechanical methods}
- 16/4408 . . . {by purging residual gases from the reaction chamber or gas lines}
- 16/4409 . . . {characterised by sealing means}
- 16/4411 . . {Cooling of the reaction chamber walls [\(C23C 16/45572 takes precedence\)](#)}
- 16/4412 . . {Details relating to the exhausts, e.g. pumps, filters, scrubbers, particle traps}
- 16/4414 . . {Electrochemical vapour deposition [EVD]}
- 16/4415 . . {Acoustic wave CVD}
- 16/4417 . . {Methods specially adapted for coating powder}
- 16/4418 . . {Methods for making free-standing articles [\(C23C 16/01 takes precedence\)](#)}
- 16/442 . . using fluidised bed process
- 16/448 . . characterised by the method used for generating reactive gas streams, e.g. by evaporation or sublimation of precursor materials
- 16/4481 . . . {by evaporation using carrier gas in contact with the source material [\(C23C 16/4486 takes precedence\)](#)}
- 16/4482 {by bubbling of carrier gas through liquid source material}
- 16/4483 {using a porous body}
- 16/4485 . . . {by evaporation without using carrier gas in contact with the source material [\(C23C 16/4486 takes precedence\)](#)}
- 16/4486 . . . {by producing an aerosol and subsequent evaporation of the droplets or particles}
- 16/4487 . . . {by using a condenser}
- 16/4488 . . . {by in situ generation of reactive gas by chemical or electrochemical reaction}
- 16/452 . . . by activating reactive gas streams before {their} introduction into the reaction chamber, e.g. by {ionisation} or addition of reactive species
- 16/453 . . passing the reaction gases through burners or torches, e.g. atmospheric pressure CVD [\(C23C 16/513 takes precedence; for flame or plasma spraying of coating material in the molten state C23C 4/00\)](#)
- 16/455 . . characterised by the method used for introducing gases into reaction chamber or for modifying gas flows in reaction chamber
- 16/45502 . . . {Flow conditions in reaction chamber}
- 16/45504 {Laminar flow}
- 16/45506 {Turbulent flow}
- 16/45508 {Radial flow}
- 16/4551 {Jet streams}
- 16/45512 . . . {Premixing before introduction in the reaction chamber}
- 16/45514 . . . {Mixing in close vicinity to the substrate}
- 16/45517 . . . {Confinement of gases to vicinity of substrate}
- 16/45519 . . . {Inert gas curtains}

- 16/45521 {the gas, other than thermal contact gas, being introduced the rear of the substrate to flow around its periphery}
- 16/45523 {Pulsed gas flow or change of composition over time}
- 16/45525 {Atomic layer deposition [ALD]}
- 16/45527 {characterized by the ALD cycle, e.g. different flows or temperatures during half-reactions, unusual pulsing sequence, use of precursor mixtures or auxiliary reactants or activations}
- 16/45529 {specially adapted for making a layer stack of alternating different compositions or gradient compositions}
- 16/45531 {specially adapted for making ternary or higher compositions}
- 16/45534 {Use of auxiliary reactants other than used for contributing to the composition of the main film, e.g. catalysts, activators or scavengers}
- 16/45536 {Use of plasma, radiation or electromagnetic fields}
- 16/45538 {Plasma being used continuously during the ALD cycle}
- 16/4554 {Plasma being used non-continuously in between ALD reactions
([C23C 16/56 takes precedence](#))}
- 16/45542 {Plasma being used non-continuously during the ALD reactions}
- 16/45544 {characterized by the apparatus}
- 16/45546 {specially adapted for a substrate stack in the ALD reactor}
- 16/45548 {having arrangements for gas injection at different locations of the reactor for each ALD half-reaction}
- 16/45551 {for relative movement of the substrate and the gas injectors or half-reaction reactor compartments}
- 16/45553 {characterized by the use of precursors specially adapted for ALD}
- 16/45555 {applied in non-semiconductor technology}
- 16/45557 . . . {Pulsed pressure or control pressure}
- 16/45559 . . . {Diffusion of reactive gas to substrate}
- 16/45561 . . . {Gas plumbing upstream of the reaction chamber}
- 16/45563 . . . {Gas nozzles}
- 16/45565 . . . {Shower nozzles}
- 16/45568 . . . {Porous nozzles}
- 16/4557 . . . {Heated nozzles}
- 16/45572 . . . {Cooled nozzles}
- 16/45574 . . . {Nozzles for more than one gas}
- 16/45576 . . . {Coaxial inlets for each gas}
- 16/45578 . . . {Elongated nozzles, tubes with holes}
- 16/4558 . . . {Perforated rings}
- 16/45582 . . . {Expansion of gas before it reaches the substrate}
- 16/45585 . . . {Compression of gas before it reaches the substrate}
- 16/45587 . . . {Mechanical means for changing the gas flow}
- 16/45589 . . . {Movable means, e.g. fans}
- 16/45591 . . . {Fixed means, e.g. wings, baffles}
- 16/45593 . . . {Recirculation of reactive gases}
- 16/45595 . . . {Atmospheric CVD gas inlets with no enclosed reaction chamber}
- 16/45597 . . . {Reactive back side gas}
- 16/458 . . . characterised by the method used for supporting substrates in the reaction chamber
- 16/4581 . . . {characterised by material of construction or surface finish of the means for supporting the substrate}
- 16/4582 . . . {Rigid and flat substrates, e.g. plates or discs
([C23C 16/4581 takes precedence](#))}
- 16/4583 {the substrate being supported substantially horizontally}
- 16/4584 {the substrate being rotated}
- 16/4585 {Devices at or outside the perimeter of the substrate support, e.g. clamping rings, shrouds}
- 16/4586 {Elements in the interior of the support, e.g. electrodes, heating or cooling devices}
- 16/4587 {the substrate being supported substantially vertically}
- 16/4588 {the substrate being rotated}
- 16/46 . . . characterised by the method used for heating the substrate ([C23C 16/48](#), [C23C 16/50 take precedence](#))
- 16/463 . . . {Cooling of the substrate}
- 16/466 . . . {using thermal contact gas}
- 16/48 . . . by irradiation, e.g. photolysis, radiolysis, particle radiation
- 16/481 . . . {by radiant heating of the substrate}
- 16/482 . . . {using incoherent light, UV to IR, e.g. lamps}
- 16/483 . . . {using coherent light, UV to IR, e.g. lasers}
- 16/484 . . . {using X-ray radiation}
- 16/485 . . . {using synchrotron radiation}
- 16/486 . . . {using ion beam radiation}
- 16/487 . . . {using electron radiation}
- 16/488 . . . {Protection of windows for introduction of radiation into the coating chamber}
- 16/50 . . . using electric discharges {([generation and control of plasma in discharge tubes for surface treatment H01J 37/32](#), [H01J 37/34](#))}
- 16/503 . . . using dc or ac discharges
- 16/505 . . . using radio frequency discharges
- 16/507 using external electrodes, e.g. in tunnel type reactors
- 16/509 using internal electrodes
- 16/5093 {Coaxial electrodes}
- 16/5096 {Flat-bed apparatus}
- 16/511 . . . using microwave discharges
- 16/513 . . . using plasma jets
- 16/515 . . . using pulsed discharges
- 16/517 . . . using a combination of discharges covered by two or more of groups
[C23C 16/503 - C23C 16/515](#)
- 16/52 . . . Controlling or regulating the coating process
{([C23C 16/45557](#), [C23C 16/279 take precedence](#))}
- 16/54 . . . Apparatus specially adapted for continuous coating
- 16/545 . . . {for coating elongated substrates}
- 16/56 . . . After-treatment

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

NOTE

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

- 18/02 . by thermal decomposition
- 18/04 . . Pretreatment of the material to be coated
(C23C 18/06 takes precedence)
- 18/06 . . Coating on selected surface areas, e.g. using masks
- 18/08 . . characterised by the deposition of metallic material
- 18/10 . . . Deposition of aluminium only
- 18/12 . . characterised by the deposition of inorganic material other than metallic material
- 18/1204 . . . {inorganic material, e.g. non-oxide and non-metallic such as sulfides, nitrides based compounds}
- 18/1208 {Oxides, e.g. ceramics}
- 18/1212 {Zeolites, glasses}
- 18/1216 {Metal oxides (C23C 18/1212 takes precedence)}
- 18/122 {Inorganic polymers, e.g. silanes, polysilazanes, polysiloxanes}
- 18/1225 . . . {Deposition of multilayers of inorganic material}
- 18/1229 . . . {Composition of the substrate}
- 18/1233 {Organic substrates}
- 18/1237 {Composite substrates, e.g. laminated, premixed}
- 18/1241 {Metallic substrates}
- 18/1245 {Inorganic substrates other than metallic}
- 18/125 . . . {Process of deposition of the inorganic material}
- 18/1254 {Sol or sol-gel processing}
- 18/1258 {Spray pyrolysis}
- 18/1262 {involving particles, e.g. carbon nanotubes [CNT], flakes}
- 18/1266 {Particles formed *in situ*}
- 18/127 {Preformed particles}
- 18/1275 {performed under inert atmosphere}
- 18/1279 {performed under reactive atmosphere, e.g. oxidising or reducing atmospheres}
- 18/1283 {Control of temperature, e.g. gradual temperature increase, modulation of temperature}
- 18/1287 {with flow inducing means, e.g. ultrasonic}
- 18/1291 {by heating of the substrate}
- 18/1295 {with after-treatment of the deposited inorganic material}
- 18/14 . Decomposition by irradiation, e.g. photolysis, particle radiation {or by mixed irradiation sources}
- 18/143 . . {Radiation by light, e.g. photolysis or pyrolysis}
- 18/145 . . {Radiation by charged particles, e.g. electron beams or ion irradiation}
- 18/16 . by reduction or substitution, e.g. electroless plating
(C23C 18/54 takes precedence)
- 18/1601 . . {Process or apparatus}
- 18/1603 . . . {coating on selected surface areas}
- 18/1605 {by masking}
- 18/1607 {by direct patterning}
- 18/1608 {from pretreatment step, i.e. selective pre-treatment}
- 18/161 {from plating step, e.g. inkjet}
- 18/1612 {through irradiation means}
- 18/1614 {plating on one side}
- 18/1616 {interior or inner surface}
- 18/1617 . . . {Purification and regeneration of coating baths}
- 18/1619 . . . {Apparatus for electroless plating}
- 18/1621 {Protection of inner surfaces of the apparatus}
- 18/1623 {through electrochemical processes}
- 18/1625 {through chemical processes}
- 18/1626 {through mechanical processes}
- 18/1628 {Specific elements or parts of the apparatus}
- 18/163 {Supporting devices for articles to be coated}
- 18/1632 {Features specific for the apparatus, e.g. layout of cells and of its equipment, multiple cells}
- 18/1633 . . . {Process of electroless plating}
- 18/1635 {Composition of the substrate}
- 18/1637 {metallic substrate}
- 18/1639 {Substrates other than metallic, e.g. inorganic or organic or non-conductive}
- 18/1641 {Organic substrates, e.g. resin, plastic}
- 18/1642 {semiconductor (semiconductor H01L 21/288)}
- 18/1644 {porous substrates}
- 18/1646 {Characteristics of the product obtained}
- 18/1648 {Porous product}
- 18/165 {Multilayered product (layered product B32B)}
- 18/1651 {Two or more layers only obtained by electroless plating}
- 18/1653 {Two or more layers with at least one layer obtained by electroless plating and one layer obtained by electroplating}
- 18/1655 {Process features}
- 18/1657 {Electroless forming, i.e. substrate removed or destroyed at the end of the process}
- 18/1658 {with two steps starting with metal deposition followed by addition of reducing agent}
- 18/166 {with two steps starting with addition of reducing agent followed by metal deposition}
- 18/1662 {Use of incorporated material in the solution or dispersion, e.g. particles, whiskers, wires}
- 18/1664 {with additional means during the plating process}
- 18/1666 {Ultrasonics}
- 18/1667 {Radiant energy, e.g. laser}
- 18/1669 {Agitation, e.g. air introduction}
- 18/1671 {Electric field}
- 18/1673 {Magnetic field}
- 18/1675 {Process conditions}
- 18/1676 {Heating of the solution}
- 18/1678 {Heating of the substrate}

- 18/168 {Control of temperature, e.g. temperature of bath, substrate}
- 18/1682 {Control of atmosphere}
- 18/1683 {Control of electrolyte composition, e.g. measurement, adjustment ([regeneration of bath C23C 18/1617](#))}
- 18/1685 {with supercritical condition, e.g. chemical fluid deposition}
- 18/1687 {with ionic liquid}
- 18/1689 {After-treatment}
- 18/1691 {Cooling, e.g. forced or controlled cooling}
- 18/1692 {Heat-treatment}
- 18/1694 {Sequential heat treatment}
- 18/1696 {Control of atmosphere}
- 18/1698 {Control of temperature}
- 18/18 . . . Pretreatment of the material to be coated
- 18/1803 . . . {of metallic material surfaces or of a non-specific material surfaces}
- 18/1806 {by mechanical pretreatment, e.g. grinding, sanding}
- 18/181 {by formation of electrostatic charges, e.g. tribofriction}
- 18/1813 {by radiant energy}
- 18/1817 {Heat}
- 18/182 {Radiation, e.g. UV, laser}
- 18/1824 {by chemical pretreatment}
- 18/1827 {only one step pretreatment}
- 18/1831 {Use of metal, e.g. activation, sensitisation with noble metals}
- 18/1834 {Use of organic or inorganic compounds other than metals, e.g. activation, sensitisation with polymers}
- 18/1837 {Multistep pretreatment}
- 18/1841 {with use of metal first}
- 18/1844 {with use of organic or inorganic compounds other than metals, first}
- 18/1848 {by electrochemical pretreatment}
- 18/1851 . . . {of surfaces of non-metallic or semiconducting in organic material}
- 18/1855 {by mechanical pretreatment, e.g. grinding, sanding}
- WARNING**
- the groups [C23C 18/1855](#) - [C23C 18/1896](#) are not complete, pending reorganisation. See also [C23C 18/18](#)
- 18/1858 {by formation of electrostatic charges, e.g. tribofriction}
- 18/1862 {by radiant energy}
- 18/1865 {Heat}
- 18/1868 {Radiation, e.g. UV, laser}
- 18/1872 {by chemical pretreatment}
- 18/1875 {only one step pretreatment}
- 18/1879 {Use of metal, e.g. activation, sensitisation with noble metals}
- 18/1882 {Use of organic or inorganic compounds other than metals, e.g. activation, sensitisation with polymers}
- 18/1886 {Multistep pretreatment}
- 18/1889 {with use of metal first}
- 18/1893 {with use of organic or inorganic compounds other than metals, first}
- 18/1896 {by electrochemical pretreatment}
- 18/20 of organic surfaces, e.g. resins
- 18/2006 {by other methods than those of [C23C 18/22](#) - [C23C 18/30](#)}
- 18/2013 {by mechanical pretreatment, e.g. grinding, sanding}
- WARNING**
- the groups [C23C 18/2013](#) - [C23C 18/2093](#) are not complete, pending reorganisation. See also [C23C 18/2006](#)
- 18/202 {by formation of electrostatic charges, e.g. tribofriction}
- 18/2026 {by radiant energy}
- 18/2033 {Heat}
- 18/204 {Radiation, e.g. UV, laser}
- 18/2046 {by chemical pretreatment}
- 18/2053 {only one step pretreatment}
- 18/206 {Use of metal other than noble metals and tin, e.g. activation, sensitisation with metals ([sensitising with tin C23C 18/285](#), [sensitising with noble metals C23C 18/30](#))}
- 18/2066 {Use of organic or inorganic compounds other than metals, e.g. activation, sensitisation with polymers}
- 18/2073 {Multistep pretreatment}
- 18/208 {with use of metal first}
- 18/2086 {with use of organic or inorganic compounds other than metals, first}
- 18/2093 {by electrochemical pretreatment}
- 18/22 Roughening, e.g. by etching
- 18/24 using acid aqueous solutions
- 18/26 using organic liquids
- 18/28 Sensitising or activating
- 18/285 {Sensitising or activating with tin based compound or composition}
- 18/30 Activating {or accelerating or sensitising with palladium or other noble metal}
- 18/31 . . . Coating with metals
- 18/32 . . . Coating with nickel, cobalt or mixtures thereof with phosphorus or boron ([C23C 18/50](#) takes precedence)
- 18/34 using reducing agents
- 18/36 using hypophosphites
- 18/38 . . . Coating with copper
- 18/40 using reducing agents
- 18/405 {Formaldehyde}
- 18/42 . . . Coating with noble metals
- 18/44 using reducing agents
- 18/48 . . . Coating with alloys
- 18/50 . . . with alloys based on iron, cobalt or nickel
- 18/52 . . . using reducing agents for coating with metallic material not provided for in a single one of groups [C23C 18/32](#) - [C23C 18/50](#)
- 18/54 . . . Contact plating, i.e. electroless electrochemical plating

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	22/36	. . . . containing also phosphates
		22/361	. . . . . {containing titanium, zirconium or hafnium compounds}
	NOTE	22/362	. . . . . {containing also zinc cations}
	This group covers also suspensions containing non-reactive liquids and reactive solid particles.	22/364	. . . . . {containing also manganese cations}
		22/365	. . . . . {containing also zinc and nickel cations}
		22/367	. . . . . {containing alkaline earth metal cations}
20/02	. Coating with metallic material	22/368	. . . . . {containing magnesium cations}
20/04	. . with metals	22/37	. . . . containing also hexavalent chromium compounds
20/06	. Coating with inorganic material, other than metallic material	22/38	. . . . . containing also phosphates
20/08	. . with compounds, mixtures or solid solutions, e.g. borides, carbides, nitrides	22/40	. . . containing molybdates, tungstates or vanadates
		22/42	. . . . containing also phosphates
		22/43	. . . . containing also hexavalent chromium compounds
Chemical surface treatment of metallic material by reaction of the surface with a reactive medium (with a reactive gas C23C 8/00)		22/44	. . . . containing also fluorides or complex fluorides
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	22/46	. . . containing oxalates
	NOTES	22/47	. . . . containing also phosphates
	1. This group covers also suspensions containing reactive liquids and non-reactive solid particles.	22/48	. . . not containing phosphates, hexavalent chromium compounds, fluorides or complex fluorides, molybdates, tungstates, vanadates or oxalates
	2. In groups C23C 22/02 - C23C 22/86, in the absence of an indication to the contrary, classification is made in the last appropriate place.	22/50	. . . . Treatment of iron or alloys based thereon
	3. Rejuvenating of the bath is classified in the appropriate place for the specific bath composition.	22/52	. . . . Treatment of copper or alloys based thereon
		22/53	. . . . Treatment of zinc or alloys based thereon
		22/54	. . . . Treatment of refractory metals or alloys based thereon
22/02	. using non-aqueous solutions	22/56	. . . . Treatment of aluminium or alloys based thereon
22/03	. . containing phosphorus compounds	22/57	. . . . Treatment of magnesium or alloys based thereon
22/04	. . containing hexavalent chromium compounds	22/58	. . . . Treatment of other metallic material
22/05	. using aqueous solutions	22/60	. . using alkaline aqueous solutions with pH greater than 8
22/06	. . using aqueous acidic solutions with pH less than 6	22/62	. . . Treatment of iron or alloys based thereon
22/07	. . . containing phosphates	22/63	. . . Treatment of copper or alloys based thereon
22/08	. . . . Orthophosphates	22/64	. . . Treatment of refractory metals or alloys based thereon
22/10	. . . . . containing oxidants	22/66	. . . Treatment of aluminium or alloys based thereon
22/12	. . . . . containing zinc cations	22/67	. . . . with solutions containing hexavalent chromium
22/13	. . . . . containing also nitrate or nitrite anions	22/68	. . using aqueous solutions with pH between 6 and 8
22/14	. . . . . containing also chlorate anions	22/70	. using melts
22/16	. . . . . containing also peroxy-compounds	22/72	. . Treatment of iron or alloys based thereon
22/17	. . . . . containing also organic acids	22/73	. characterised by the process
22/18	. . . . . containing manganese cations	22/74	. . for obtaining burned-in conversion coatings
22/182	. . . . . {containing also zinc cations}	22/76	. . Applying the liquid by spraying
22/184	. . . . . {containing also nickel cations}	22/77	. . Controlling or regulating of the coating process
22/186	. . . . . {containing also copper cations}	22/78	. Pretreatment of the material to be coated
22/188	. . . . . {containing also magnesium cations}	22/80	. . with solutions containing titanium or zirconium compounds
22/20	. . . . . containing aluminium cations	22/82	. After-treatment
22/22	. . . . . containing alkaline earth metal cations	22/83	. . Chemical after-treatment
22/23	. . . . . Condensed phosphates	22/84	. . Dyeing
22/24	. . . containing hexavalent chromium compounds	22/86	. . Regeneration of coating baths
22/26	. . . . containing also organic compounds		
22/27	. . . . . Acids		
22/28	. . . . . Macromolecular compounds		
22/30	. . . . containing also trivalent chromium	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)
22/32	. . . . containing also pulverulent metals		
22/33	. . . . containing also phosphates	24/02	. by application of pressure only
22/34	. . . containing fluorides or complex fluorides		

24/04	. . Impact or kinetic deposition of particles	28/324	. . . {with at least one metal matrix material layer comprising a mixture of at least two metals or metal phases or a metal-matrix material with hard embedded particles, e.g. WC-Me}
24/045	. . . {by trembling using impacting inert media}		
24/06	. . Compressing powdered coating material, e.g. by milling	28/325	. . . {with layers graded in composition or in physical properties}
24/08	. by application of heat or pressure and heat (C23C 24/04 takes precedence)	28/34	. . {including at least one inorganic non-metallic material layer, e.g. metal carbide, nitride, boride, silicide layer and their mixtures, enamels, phosphates and sulphates}
24/082	. . {without intermediate formation of a liquid in the layer}	28/341	. . . {with at least one carbide layer}
24/085	. . . {Coating with metallic material, i.e. metals or metal alloys, optionally comprising hard particles, e.g. oxides, carbides or nitrides}	28/343	. . . {with at least one DLC or an amorphous carbon based layer, the layer being doped or not}
24/087	. . . . {Coating with metal alloys or metal elements only}	28/345	. . . {with at least one oxide layer}
24/10	. . with intermediate formation of a liquid phase in the layer	28/3455	. . . . {with a refractory ceramic layer, e.g. refractory metal oxide, ZrO ₂ , rare earth oxides or a thermal barrier system comprising at least one refractory oxide layer}
24/103	. . . {Coating with metallic material, i.e. metals or metal alloys, optionally comprising hard particles, e.g. oxides, carbides or nitrides}	28/347	. . . {with layers adapted for cutting tools or wear applications}
24/106	. . . . {Coating with metal alloys or metal elements only}	28/36	. . {including layers graded in composition or physical properties}
26/00	Coating not provided for in groups C23C 2/00 - C23C 24/00	28/40	. {Coatings including alternating layers following a pattern, a periodic or defined repetition}
26/02	. applying molten material to the substrate	28/42	. . {characterized by the composition of the alternating layers}
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	28/44	. . {characterized by a measurable physical property of the alternating layer or system, e.g. thickness, density, hardness}
28/02	. only coatings {only including layers} of metallic material	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)
28/021	. . {including at least one metal alloy layer}	30/005	. {on hard metal substrates}
28/022	. . . {with at least one MCrAlX layer}		
28/023	. . {only coatings of metal elements only}		
28/025	. . . {with at least one zinc-based layer}		
28/026	. . {including at least one amorphous metallic material layer}		
28/027	. . {including at least one metal matrix material comprising a mixture of at least two metals or metal phases or metal matrix composites, e.g. metal matrix with embedded inorganic hard particles, CERMET, MMC.}		
28/028	. . {Including graded layers in composition or in physical properties, e.g. density, porosity, grain size}		
28/04	. only coatings of inorganic non-metallic material		
28/042	. . {including a refractory ceramic layer, e.g. refractory metal oxides, ZrO ₂ , rare earth oxides}		
28/044	. . {coatings specially adapted for cutting tools or wear applications}		
28/046	. . {with at least one amorphous inorganic material layer, e.g. DLC, a-C:H, a-C:Me, the layer being doped or not}		
28/048	. . {with layers graded in composition or physical properties}		
28/30	. {Coatings combining at least one metallic layer and at least one inorganic non-metallic layer}		
28/32	. . {including at least one pure metallic layer}		
28/321	. . . {with at least one metal alloy layer}		
28/3215	. . . . {at least one MCrAlX layer}		
28/322	. . . {only coatings of metal elements only}		
28/3225 {with at least one zinc-based layer}		
28/323	. . . {with at least one amorphous metallic material layer}		
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2222/00	Aspects relating to chemical surface treatment of metallic material by reaction of the surface with a reactive medium		
2222/10	. Use of solutions containing trivalent chromium but free of hexavalent chromium		
2222/20	. Use of solutions containing silanes		