CPC COOPERATIVE PATENT CLASSIFICATION

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

(applying liquids or other fluent materials to surfaces in general B05; 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; working of metal by the action of a high concentration of electric current on a workpiece using an electrode B23H; metallising of glass C03C; metallising mortars, concrete, artificial stone, ceramics or natural stone C04B 41/00; paints varnishes, laquers C09D; enamelling of, or applying a vitreous layer to, metals C23D; inhibiting corrosion of metallic material or incrustation in general C23F; single-crystal film growth C30B; manufacture of semiconductor devices H01L; manufacture of printed circuits H05K)

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 used in the CPC scheme. Subject matter covered by these groups is classified in the following CPC groups:

C23C 14/36 - C23C 14/44	covered by	C23C 14/34 and subgroups.
C23C 18/28	covered by	C23C 18/2006 - C23C 18/2093

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 . Pre-treatment 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 (controlling or regulating thickness in general G05D 5/02)

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 . Pre-treatment 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

NOTE

In this group, multi-aspect classification is applied, so that subject matter characterised by aspects covered by more than one of its subgroups should be classified in each of those subgroups.

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 . Pre-treatment 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 . . onyl 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 (discharge tubes with provision for introducing objects or material to be exposed to the discharge H01J 37/00)
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 (discharge tubes with provision for introducing objects or material to be exposed to the discharge H01J 37/00)
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 O_2, H_2O, N_2, NH_3 or CH_4}
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 . Pre-treatment 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 ABO_3 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 (controlling or regulating in general G05)
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 . . {Plasma treatment}
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 ABO_3 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 }; controlling or regulating in general G05)
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** (chemical surface reaction C23C 8/00, C23C 22/00)**; Contact plating**

NOTE

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

18/02 . by thermal decomposition
18/04 . . Pre-treatment 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

WARNING

Groups C23C 18/1204 - C23C 18/1295 are not complete pending a reorganisation. See also this group

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
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}

WARNING

the groups C23C 18/1605 - C23C 18/1616 are not complete, pending reorganisation. See also C23C 18/1603

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}

WARNING

the groups C23C 18/1619 - C23C 18/1698 are not complete, pending reorganisation. See also C23C 18/1601

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 . . Pre-treatment of the material to be coated
18/1803 . . . {of metallic material surfaces or of a non-specific material surfaces}

WARNING

the groups C23C 18/1803 - C23C 18/1848 are not complete, pending reorganisation. See also C23C 18/18

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 {(not used, see subgroups)}
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 (chemical surface reaction C23C 8/00, C23C 22/00)

NOTE

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

20/02 . Coating with metallic material
20/04 . . with metals
20/06 . Coating with inorganic material, other than metallic material
20/08 . . with compounds, mixtures or solid solutions, e.g. borides, carbides, nitrides

Chemical surface treatment of metallic material by reaction of the surface with a reactive medium (with a reactive gas C23C 8/00)

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 (wash primers C09D 5/12)

NOTES

1. This group covers also suspensions containing reactive liquids and non-reactive solid particles.
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.
3. Rejuvenating of the bath is classified in the appropriate place for the specific bath composition.

22/02 . using non-aqueous solutions
22/03 . . containing phosphorus compounds
22/04 . . containing hexavalent chromium compounds
22/05 . using aqueous solutions
22/06 . . using aqueous acidic solutions with pH less than 6
22/07 . . . containing phosphates
22/08 . . . . Orthophosphates
22/10 . . . . . containing oxidants
22/12 . . . . . containing zinc cations
22/13 . . . . . containing also nitrate or nitrite anions
22/14 . . . . . containing also chlorate anions
22/16 . . . . . containing also peroxy-compounds
22/17 . . . . . containing also organic acids
22/18 . . . . . containing manganese cations
22/182 . . . . . {containing also zinc cations}
22/184 . . . . . {containing also nickel cations}
22/186 . . . . . {containing also copper cations}
22/188 . . . . . {containing also magnesium cations}
22/20 . . . . . containing aluminium cations
22/22 . . . . . containing alkaline earth metal cations
22/23 . . . . Condensed phosphates
22/24 . . . containing hexavalent chromium compounds
22/26 . . . . containing also organic compounds
22/27 . . . . . Acids
22/28 . . . . . Macromolecular compounds
22/30 . . . . containing also trivalent chromium
22/32 . . . . containing also pulverulent metals
22/33 . . . . containing also phosphates
22/34 . . . containing fluorides or complex fluorides
22/36 . . . . containing also phosphates
22/361 . . . . . {containing titanium, zirconium or hafnium compounds}
22/362 . . . . . {containing also zinc cations}
22/364 . . . . . {containing also manganese cations}
22/365 . . . . . {containing also zinc and nickel cations}
22/367 . . . . . {containing alkaline earth metal cations}
22/368 . . . . . {containing magnesium cations}
22/37 . . . . containing also hexavalent chromium compounds
22/38 . . . . . containing also phosphates
22/40 . . . containing molybdates, tungstates or vanadates
22/42 . . . . containing also phosphates
22/43 . . . . containing also hexavalent chromium compounds
22/44 . . . . containing also fluorides or complex fluorides
22/46 . . . containing oxalates
22/47 . . . . containing also phosphates
22/48 . . . not containing phosphates, hexavalent chromium compounds, fluorides or complex fluorides, molybdates, tungstates, vanadates or oxalates
22/50 . . . . Treatment of iron or alloys based thereon
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
22/56 . . . . Treatment of aluminium or alloys based thereon
22/57 . . . . Treatment of magnesium or alloys based thereon
22/58 . . . . Treatment of other metallic material
22/60 . . using alkaline aqueous solutions with pH greater than 8
22/62 . . . Treatment of iron or alloys based thereon
22/63 . . . Treatment of copper or alloys based thereon
22/64 . . . Treatment of refractory metals or alloys based thereon

22/66 . . . Treatment of aluminium or alloys based thereon
22/67 . . . . with solutions containing hexavalent chromium
22/68 . . using aqueous solutions with pH between 6 and 8
22/70 . using melts
22/72 . . Treatment of iron or alloys based thereon
22/73 . characterised by the process
22/74 . . for obtaining burned-in conversion coatings
22/76 . . Applying the liquid by spraying
22/77 . . Controlling or regulating of the coating process (controlling or regulating in general G05)
22/78 . Pre-treatment of the material to be coated
22/80 . . with solutions containing titanium or zirconium compounds
22/82 . After-treatment
22/83 . . Chemical after-treatment
22/84 . . Dyeing
22/86 . Regeneration of coating baths

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; manufacture of composite layers, workpieces or articles by sintering metallic powder B22F 7/00; friction welding B23K 20/12)
24/02 . by application of pressure only
24/04 . . Impact or kinetic deposition of particles
24/045 . . . {by trembling using impacting inert media}
24/06 . . Compressing powdered coating material, e.g. by milling
24/08 . by application of heat or pressure and heat (C23C 24/04 takes precedence)
24/082 . . {without intermediate formation of a liquid in the layer}
24/085 . . . {Coating with metallic material, i.e. metals or metal alloys, optionally comprising hard particles, e.g. oxides, carbides or nitrides}
24/087 . . . . {Coating with metal alloys or metal elements only}
24/10 . . with intermediate formation of a liquid phase in the layer
24/103 . . . {Coating with metallic material, i.e. metals or metal alloys, optionally comprising hard particles, e.g. oxides, carbides or nitrides}
24/106 . . . . {Coating with metal alloys or metal elements only}

26/00 Coating not provided for in groups C23C 2/00 - C23C 24/00
26/02 . applying molten material to the substrate (applying melts to surfaces, in general B05)

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
28/02 . only coatings {only including layers} of metallic material
28/021 . . {including at least one metal alloy layer}
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}
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}
28/325 . . . {with layers graded in composition or in physical properties}
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}
28/341 . . . {with at least one carbide layer}
28/343 . . . {with at least one DLC or an amorphous carbon based layer, the layer being doped or not}
28/345 . . . {with at least one oxide 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}
28/347 . . . {with layers adapted for cutting tools or wear applications}
28/36 . . {including layers graded in composition or physical properties}
28/40 . {Coatings including alternating layers following a pattern, a periodic or defined repetition}
28/42 . . {characterized by the composition of the alternating layers}
28/44 . . {characterized by a measurable physical property of the alternating layer or system, e.g. thickness, density, hardness}

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)

30/005 . {on hard metal substrates}

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