

CPC COOPERATIVE PATENT CLASSIFICATION**C CHEMISTRY; METALLURGY**
*(NOTES omitted)***METALLURGY****C30 CRYSTAL GROWTH**

C30B SINGLE-CRYSTAL GROWTH (by using ultra-high pressure, e.g. for the formation of diamonds, [B01J 3/06](#)); **UNIDIRECTIONAL SOLIDIFICATION OF EUTECTIC MATERIAL OR UNIDIRECTIONAL DEMIXING OF EUTECTOID MATERIAL; REFINING BY ZONE-MELTING OF MATERIAL** (zone-refining of metals or alloys [C22B](#)); **PRODUCTION OF A HOMOGENEOUS POLYCRYSTALLINE MATERIAL WITH DEFINED STRUCTURE** (casting of metals, casting of other substances by the same processes or devices [B22D](#); working of plastics [B29](#); modifying the physical structure of metals or alloys [C21D](#), [C22F](#)); **SINGLE CRYSTALS OR HOMOGENEOUS POLYCRYSTALLINE MATERIAL WITH DEFINED STRUCTURE; AFTER-TREATMENT OF SINGLE CRYSTALS OR A HOMOGENEOUS POLYCRYSTALLINE MATERIAL WITH DEFINED STRUCTURE** (for producing semiconductor devices or parts thereof [H01L](#), [H10](#)); **APPARATUS THEREFOR**

NOTES

1. In this subclass, the following expressions are used with the meaning indicated:
 - "single-crystal" includes also twin crystals and a predominantly single crystal product;
 - "homogeneous polycrystalline material" means a material with crystal particles, all of which have the same chemical composition;
 - "defined structure" means the structure of a material with grains which are oriented in a preferential way or have larger dimensions than normally obtained.
2. In this subclass:
 - the preparation of crystals or a homogeneous polycrystalline material with defined structure of particular materials or shapes is classified in the group for the process as well as in group [C30B 29/00](#);
 - an apparatus specially adapted for a specific process is classified in the appropriate group for the process. Apparatus to be used in more than one kind of process is classified in group [C30B 35/00](#).

WARNING

In this subclass non-limiting references (in the sense of paragraph 39 of the Guide to the IPC) may still be displayed in the scheme.

Single-crystal growth from solids or gels

- 1/00 Single-crystal growth directly from the solid state** ([unidirectional demixing of eutectoid materials C30B 3/00](#); under a protective fluid [C30B 27/00](#))
- 1/02 . by thermal treatment, e.g. strain annealing ([C30B 1/12 takes precedence](#))
 - 1/023 . . {from solids with amorphous structure}
 - 1/026 . . {Solid phase epitaxial growth through a disordered intermediate layer}
 - 1/04 . . Isothermal recrystallisation
 - 1/06 . . Recrystallisation under a temperature gradient
 - 1/08 . . . Zone recrystallisation
 - 1/10 . by solid state reactions or multi-phase diffusion
 - 1/12 . by pressure treatment during the growth
- 3/00 Unidirectional demixing of eutectoid materials**
- 5/00 Single-crystal growth from gels** (under a protective fluid [C30B 27/00](#))

5/02 . with addition of doping materials

Single-crystal growth from liquids; Unidirectional solidification of eutectic materials

- 7/00 Single-crystal growth from solutions using solvents which are liquid at normal temperature, e.g. aqueous solutions** ([from molten solvents C30B 9/00](#); [by normal or gradient freezing C30B 11/00](#); under a protective fluid [C30B 27/00](#))
- 7/005 . {Epitaxial layer growth}
 - 7/02 . by evaporation of the solvent
 - 7/04 . . using aqueous solvents
 - 7/06 . . using non-aqueous solvents
 - 7/08 . by cooling of the solution
 - 7/10 . by application of pressure, e.g. hydrothermal processes
 - 7/105 . . {using ammonia as solvent, i.e. ammonothermal processes}

7/12	. by electrolysis	13/14	. Crucibles or vessels
7/14	. the crystallising materials being formed by chemical reactions in the solution	13/16	. Heating of the molten zone
9/00	Single-crystal growth from melt solutions using molten solvents (by normal or gradient freezing C30B 11/00; by zone-melting C30B 13/00; by crystal pulling C30B 15/00; on immersed seed crystal C30B 17/00; by liquid phase epitaxial growth C30B 19/00; under a protective fluid C30B 27/00)	13/18	. . the heating element being in contact with, or immersed in, the molten zone
9/02	. by evaporation of the molten solvent	13/20	. . by induction, e.g. hot wire technique (C30B 13/18 takes precedence)
9/04	. by cooling of the solution	13/22	. . by irradiation or electric discharge
9/06	. . using as solvent a component of the crystal composition	13/24	. . . using electromagnetic waves
9/08	. . using other solvents	13/26	. Stirring of the molten zone
9/10	. . . Metal solvents	13/28	. Controlling or regulating
9/12	. . . Salt solvents, e.g. flux growth	13/285	. . {Crystal holders, e.g. chucks}
9/14	. by electrolysis	13/30	. . Stabilisation or shape controlling of the molten zone, e.g. by concentrators, by electromagnetic fields; Controlling the section of the crystal
11/00	Single-crystal growth by normal freezing or freezing under temperature gradient, e.g. Bridgman-Stockbarger method (C30B 13/00, C30B 15/00, C30B 17/00, C30B 19/00 take precedence; under a protective fluid C30B 27/00)	13/32	. Mechanisms for moving either the charge or the heater
11/001	. {Continuous growth}	13/34	. characterised by the seed, e.g. by its crystallographic orientation
11/002	. {Crucibles or containers for supporting the melt}	15/00	Single-crystal growth by pulling from a melt, e.g. Czochralski method (under a protective fluid C30B 27/00)
11/003	. {Heating or cooling of the melt or the crystallised material}	15/002	. {Continuous growth}
11/005	. {by irradiation or electric discharge}	15/005	. {Simultaneous pulling of more than one crystal}
11/006	. {Controlling or regulating}	15/007	. {Pulling on a substrate}
11/007	. {Mechanisms for moving either the charge or the heater}	15/02	. adding crystallising materials or reactants forming it <i>in situ</i> to the melt
11/008	. {using centrifugal force to the charge}	15/04	. . adding doping materials, e.g. for n-p-junction
11/02	. without using solvents (C30B 11/06 takes precedence)	15/06	. Non-vertical pulling
11/04	. adding crystallising materials or reactants forming it <i>in situ</i> to the melt	15/08	. Downward pulling
11/06	. . at least one but not all components of the crystal composition being added	15/10	. Crucibles or containers for supporting the melt
11/065	. . . {before crystallising, e.g. synthesis}	15/12	. . Double crucible methods
11/08	. . every component of the crystal composition being added during the crystallisation	15/14	. Heating of the melt or the crystallised materials
11/10	. . . Solid or liquid components, e.g. Verneuil method	15/16	. . by irradiation or electric discharge
11/12	. . . Vaporous components, e.g. vapour-liquid-solid-growth	15/18	. . using direct resistance heating in addition to other methods of heating, e.g. using Peltier heat
11/14	. characterised by the seed, e.g. its crystallographic orientation	15/20	. Controlling or regulating (controlling or regulating in general G05)
13/00	Single-crystal growth by zone-melting; Refining by zone-melting (C30B 17/00 takes precedence; by changing the cross-section of the treated solid C30B 15/00; under a protective fluid C30B 27/00; for the growth of homogeneous polycrystalline material with defined structure C30B 28/00)	15/203	. . {the relationship of pull rate (v) to axial thermal gradient (G)}
13/005	. {Continuous growth}	15/206	. . {the thermal history of growing the ingot}
13/02	. Zone-melting with a solvent, e.g. travelling solvent process	15/22	. . Stabilisation or shape controlling of the molten zone near the pulled crystal; Controlling the section of the crystal
13/04	. Homogenisation by zone-levelling	15/24	. . . using mechanical means, e.g. shaping guides (shaping dies for edge-defined film-fed crystal growth C30B 15/34)
13/06	. the molten zone not extending over the whole cross-section	15/26	. . . using television detectors; using photo or X-ray detectors
13/08	. adding crystallising materials or reactants forming it <i>in situ</i> to the molten zone	15/28	. . . using weight changes of the crystal or the melt, e.g. flotation methods
13/10	. . . with addition of doping materials	15/30	. Mechanisms for rotating or moving either the melt or the crystal (flotation methods C30B 15/28)
13/12	. . . in the gaseous or vapour state	15/305	. . {Stirring of the melt}
		15/32	. Seed holders, e.g. chucks
		15/34	. Edge-defined film-fed crystal-growth using dies or slits
		15/36	. characterised by the seed, e.g. its crystallographic orientation
		17/00	Single-crystal growth onto a seed which remains in the melt during growth, e.g. Nacken-Kyropoulos method (C30B 15/00 takes precedence)
		19/00	Liquid-phase epitaxial-layer growth

19/02	. using molten solvents, e.g. flux	25/16	. . Controlling or regulating (controlling or regulating in general G05)
19/04	. . the solvent being a component of the crystal composition	25/165	. . . {the flow of the reactive gases}
19/06	. Reaction chambers; Boats for supporting the melt; Substrate holders	25/18	. . characterised by the substrate
19/061	. . {Tipping system, e.g. by rotation}	25/183	. . . {being provided with a buffer layer, e.g. a lattice matching layer}
19/062	. . {Vertical dipping system}	25/186	. . . {being specially pre-treated by, e.g. chemical or physical means}
19/063	. . {Sliding boat system}	25/20	. . . the substrate being of the same materials as the epitaxial layer
19/064	. . {Rotating sliding boat system}	25/205	. . . . {the substrate being of insulating material}
19/065	. . {Multiple stacked slider system}	25/22	. . Sandwich processes
19/066	. . {Injection or centrifugal force system}	27/00	Single-crystal growth under a protective fluid
19/067	. . {Boots or containers}	27/02	. by pulling from a melt
19/068	. . {Substrate holders}	28/00	Production of homogeneous polycrystalline material with defined structure
19/08	. Heating of the reaction chamber or the substrate	28/02	. directly from the solid state
19/10	. Controlling or regulating (controlling or regulating in general G05)	28/04	. from liquids
19/103	. . {Current controlled or induced growth}	28/06	. . by normal freezing or freezing under temperature gradient
19/106	. . {adding crystallising material or reactants forming it <i>in situ</i> to the liquid}	28/08	. . by zone-melting
19/12	. characterised by the substrate	28/10	. . by pulling from a melt
21/00	Unidirectional solidification of eutectic materials	28/12	. directly from the gas state
21/02	. by normal casting or gradient freezing	28/14	. . by chemical reaction of reactive gases
21/04	. by zone-melting		
21/06	. by pulling from a melt		

Single-crystal growth from vapours**23/00 Single-crystal growth by condensing evaporated or sublimed materials****NOTE**

Groups [C30B 23/002 - C30B 23/005](#)
take precedence over groups
[C30B 23/007 - C30B 23/08](#)

23/002	. {Controlling or regulating}
23/005	. . {Controlling or regulating flux or flow of depositing species or vapour}
23/007	. {Growth of whiskers or needles}
23/02	. Epitaxial-layer growth
23/025	. . {characterised by the substrate}
23/04	. . Pattern deposit, e.g. by using masks
23/06	. . Heating of the deposition chamber, the substrate or the materials to be evaporated
23/063	. . . {Heating of the substrate}
23/066	. . . {Heating of the material to be evaporated}
23/08	. . by condensing ionised vapours (by reactive sputtering C30B 25/06)

25/00 Single-crystal growth by chemical reaction of reactive gases, e.g. chemical vapour-deposition growth

25/005	. {Growth of whiskers or needles}
25/02	. Epitaxial-layer growth
25/025	. . {Continuous growth}
25/04	. . Pattern deposit, e.g. by using masks
25/06	. . by reactive sputtering
25/08	. . Reaction chambers; Selection of materials therefor
25/10	. . Heating of the reaction chamber or the substrate
25/105	. . . {by irradiation or electric discharge}
25/12	. . Substrate holders or susceptors
25/14	. . Feed and outlet means for the gases; Modifying the flow of the reactive gases

25/16	. . Controlling or regulating (controlling or regulating in general G05)
25/165	. . . {the flow of the reactive gases}
25/18	. . characterised by the substrate
25/183	. . . {being provided with a buffer layer, e.g. a lattice matching layer}
25/186	. . . {being specially pre-treated by, e.g. chemical or physical means}
25/20	. . . the substrate being of the same materials as the epitaxial layer
25/205	. . . . {the substrate being of insulating material}
25/22	. . Sandwich processes
27/00	Single-crystal growth under a protective fluid
27/02	. by pulling from a melt
28/00	Production of homogeneous polycrystalline material with defined structure
28/02	. directly from the solid state
28/04	. from liquids
28/06	. . by normal freezing or freezing under temperature gradient
28/08	. . by zone-melting
28/10	. . by pulling from a melt
28/12	. directly from the gas state
28/14	. . by chemical reaction of reactive gases
29/00	Single crystals or homogeneous polycrystalline material with defined structure characterised by the material or by their shape
	NOTES
	1. In groups C30B 29/02 - C30B 29/54 , the last place priority rule is applied, i.e. at each hierarchical level, in the absence of an indication to the contrary, a material is classified in the last appropriate place.
	2. Attention is drawn to Note (3) after the title of section C , which Note indicates to which version of the Periodic Table of chemical elements the CPC refers. In this group, the system used is the 8 group system indicated by Roman numerals in the Periodic Table thereunder.
29/02	. Elements
29/04	. . Diamond
29/06	. . Silicon
29/08	. . Germanium
29/10	. Inorganic compounds or compositions
29/12	. . Halides
29/14	. . Phosphates
29/16	. . Oxides
29/18	. . . Quartz
29/20	. . . Aluminium oxides
29/22	. . . Complex oxides
29/225	. . . . {based on rare earth copper oxides, e.g. high T-superconductors}
29/24	. . . . with formula $AMeO_3$, wherein A is a rare earth metal and Me is Fe, Ga, Sc, Cr, Co or Al, e.g. ortho ferrites
29/26	. . . . with formula BMe_2O_4 , wherein B is Mg, Ni, Co, Al, Zn, or Cd and Me is Fe, Ga, Sc, Cr, Co, or Al

29/28	. . . . . with formula $A_3Me_5O_{12}$ wherein A is a rare earth metal and Me is Fe, Ga, Sc, Cr, Co or Al, e.g. garnets	31/08	. . . the diffusion materials being a compound of the elements to be diffused
29/30	. . . . . Niobates; Vanadates; Tantalates	31/10	. . . Reaction chambers; Selection of materials therefor
29/32	. . . . . Titanates; Germanates; Molybdates; Tungstates	31/103	. . . . {Mechanisms for moving either the charge or heater}
29/34	. . . Silicates	31/106	. . . . {Continuous processes}
29/36	. . . Carbides	31/12	. . . Heating of the reaction chamber
29/38	. . . Nitrides	31/14	. . . Substrate holders or susceptors
29/40	. . . $A_{III}B_V$ compounds {wherein A is B, Al, Ga, In or Tl and B is N, P, As, Sb or Bi}	31/16	. . . Feed and outlet means for the gases; Modifying the flow of the gases
29/403	. . . . {A_{III} -nitrides}	31/165	. . . . {Diffusion sources}
29/406	. . . . . {Gallium nitride}	31/18	. . . Controlling or regulating
29/42	. . . . . Gallium arsenide	31/185	. . . . {Pattern diffusion, e.g. by using masks}
29/44	. . . . . Gallium phosphide	31/20	. . . Doping by irradiation with electromagnetic waves or by particle radiation
29/46	. . . . . Sulfur-, selenium- or tellurium-containing compounds	31/22	. . . by ion-implantation
29/48	. . . . . $A_{II}B_{VI}$ compounds {wherein A is Zn, Cd or Hg, and B is S, Se or Te}	33/00	After-treatment of single crystals or homogeneous polycrystalline material with defined structure (C30B 31/00 takes precedence)
29/50	. . . . . Cadmium sulfide	33/005	. . . . {Oxydation}
29/52	. . . . . Alloys	33/02	. . . Heat treatment (C30B 33/04, C30B 33/06 take precedence)
29/54	. . . . . Organic compounds	33/04	. . . using electric or magnetic fields or particle radiation
29/56	. . . . . Tartrates	33/06	. . . Joining of crystals
29/58	. . . . . Macromolecular compounds	33/08	. . . Etching
29/60	. . . . . characterised by shape	33/10	. . . in solutions or melts
29/602	. . . . . {Nanotubes}	33/12	. . . in gas atmosphere or plasma
29/605	. . . . . {Products containing multiple oriented crystallites, e.g. columnar crystallites}	35/00	Apparatus not otherwise provided for, specially adapted for the growth, production or after-treatment of single crystals or of a homogeneous polycrystalline material with defined structure
29/62	. . . . . Whiskers or needles	35/002	. . . . {Crucibles or containers}
29/64	. . . . . Flat crystals, e.g. plates, strips or discs	35/005	. . . . {Transport systems}
29/66	. . . . . Crystals of complex geometrical shape, e.g. tubes, cylinders	35/007	. . . . {Apparatus for preparing, pre-treating the source material to be used for crystal growth}
29/68	. . . . . Crystals with laminate structure, e.g. "superlattices"		
30/00	Production of single crystals or homogeneous polycrystalline material with defined structure characterised by the action of electric or magnetic fields, wave energy or other specific physical conditions		

NOTE

When classifying in this group, classification is also made in groups [C30B 1/00 - C30B 27/00](#) according to the process of crystal growth.

- 30/02 . using electric fields, e.g. electrolysis
- 30/04 . using magnetic fields
- 30/06 . using mechanical vibrations
- 30/08 . in conditions of zero-gravity or low gravity

After-treatment of single crystals or homogeneous polycrystalline material with defined structure

- 31/00 Diffusion or doping processes for single crystals or homogeneous polycrystalline material with defined structure; Apparatus therefor**
- 31/02 . by contacting with diffusion materials in the solid state
- 31/04 . by contacting with diffusion materials in the liquid state
- 31/045 . . . {by electrolysis}
- 31/06 . by contacting with diffusion material in the gaseous state