

CPC COOPERATIVE PATENT CLASSIFICATION

C CHEMISTRY; METALLURGY

(NOTES omitted)

METALLURGY

C30 CRYSTAL GROWTH (separation by crystallisation in general [B01D 9/00](#))

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](#)); **APPARATUS THEREFOR**

NOTES

- 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.
- In this subclass:
 - the preparation of single 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](#).
- After the notation of [C30B](#) and separated therefrom by a + sign, notations concerning the particular composition or shape of the material may be added. These notations are selected from [C30B 29/00](#).

Example: A crystal-growth process by zone-melting directly related to Al_2O_3 crystal material is classified in [C30B 13/00](#) + [C30B 29/20](#)

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:

[C30B 29/64](#), [C30B 29/66](#) covered by [C30B 29/60](#)

Single-crystal growth from solids or gels

		1/12	• by pressure treatment during the growth
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)	3/00	Unidirectional demixing of eutectoid materials
1/02	• by thermal treatment, e.g. strain annealing (C30B 1/12 takes precedence)	5/00	Single-crystal growth from gels (under a protective fluid C30B 27/00)
1/023	• • {from solids with amorphous structure}	5/02	• with addition of doping materials
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		

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

		11/10	. . . Solid or liquid components, e.g. Verneuil method
		11/12	. . . Vaporous components, e.g. vapour-liquid-solid-growth
		11/14	. characterised by the seed, e.g. its crystallographic orientation
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)	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; zone-refining of specific materials, see the relevant subclasses for the materials)
7/005	. {Epitaxial layer growth}		
	WARNING		
	Group C30B 7/005 is not complete, see also C30B 7/00		
7/02	. by evaporation of the solvent	13/005	. {Continuous growth}
7/04	. . using aqueous solvents	13/02	. Zone-melting with a solvent, e.g. travelling solvent process
7/06	. . using non-aqueous solvents	13/04	. Homogenisation by zone-levelling
7/08	. by cooling of the solution	13/06	. the molten zone not extending over the whole cross-section
7/10	. by application of pressure, e.g. hydrothermal processes	13/08	. adding crystallising materials or reactants forming it <u>in situ</u> to the molten zone
7/105	. . {using ammonia as solvent, i.e. ammonothermal processes}	13/10	. . with addition of doping materials
7/12	. by electrolysis	13/12	. . . in the gaseous or vapour state
7/14	. the crystallising materials being formed by chemical reactions in the solution	13/14	. Crucibles or vessels
		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; induction coils H05B 6/36)
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 (controlling or regulating in general G05)
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 <u>in situ</u> 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 <u>in situ</u> 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
		15/16	. . by irradiation or electric discharge
		15/18	. . using direct resistance heating in addition to other methods of heating, e.g. using Peltier heat
		15/20	. Controlling or regulating (controlling or regulating in general G05)
		15/203	. . {the relationship of pull rate (v) to axial thermal gradient (G)}

15/206	. . {the thermal history of growing the ingot}	23/005	. . {Controlling or regulating flux or flow of depositing species or vapour}
15/22	. . Stabilisation or shape controlling of the molten zone near the pulled crystal; Controlling the section of the crystal	23/007	. {Growth of whiskers or needles}
15/24	. . . using mechanical means, e.g. shaping guides (shaping dies for edge-defined film-fed crystal growth C30B 15/34)	23/02	. Epitaxial-layer growth
15/26	. . . using television detectors; using photo or X-ray detectors	23/025	. . {characterised by the substrate}
15/28	. . . using weight changes of the crystal or the melt, e.g. flotation methods	23/04	. . Pattern deposit, e.g. by using masks
15/30	. Mechanisms for rotating or moving either the melt or the crystal (flotation methods C30B 15/28)	23/06	. . Heating of the deposition chamber, the substrate or the materials to be evaporated
15/305	. . {Stirring of the melt}	23/063	. . . {Heating of the substrate}
15/32	. Seed holders, e.g. chucks		WARNING
15/34	. Edge-defined film-fed crystal-growth using dies or slits		Group C30B 23/063 is not complete, see also C30B 23/06
15/36	. characterised by the seed, e.g. its crystallographic orientation	23/066	. . . {Heating of the material to be evaporated}
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)		WARNING
19/00	Liquid-phase epitaxial-layer growth		Group C30B 23/066 is not complete, see also C30B 23/06
19/02	. using molten solvents, e.g. flux	23/08	. . by condensing ionised vapours (by reactive sputtering C30B 25/06)
19/04	. . the solvent being a component of the crystal composition	25/00	Single-crystal growth by chemical reaction of reactive gases, e.g. chemical vapour-deposition growth
19/06	. Reaction chambers; Boats for supporting the melt; Substrate holders	25/005	. {Growth of whiskers or needles}
19/061	. . {Tipping system, e.g. by rotation}	25/02	. Epitaxial-layer growth
19/062	. . {Vertical dipping system}	25/025	. . {Continuous growth}
19/063	. . {Sliding boat system}	25/04	. . Pattern deposit, e.g. by using masks
19/064	. . {Rotating sliding boat system}	25/06	. . by reactive sputtering
19/065	. . {Multiple stacked slider system}	25/08	. . Reaction chambers; Selection of materials therefor
19/066	. . {Injection or centrifugal force system}	25/10	. . Heating of the reaction chamber or the substrate
19/067	. . {Boots or containers}	25/105	. . . {by irradiation or electric discharge}
19/068	. . {Substrate holders}	25/12	. . Substrate holders or susceptors
19/08	. Heating of the reaction chamber or the substrate	25/14	. . Feed and outlet means for the gases; Modifying the flow of the reactive gases
19/10	. Controlling or regulating (controlling or regulating in general G05)	25/16	. . Controlling or regulating (controlling or regulating in general G05)
19/103	. . {Current controlled or induced growth}	25/165	. . . {the flow of the reactive gases}
19/106	. . {adding crystallising material or reactants forming it <i>in situ</i> to the liquid}		WARNING
19/12	. characterised by the substrate		Not complete pending reclassification, see also group C30B 25/14
21/00	Unidirectional solidification of eutectic materials	25/18	. . characterised by the substrate
21/02	. by normal casting or gradient freezing	25/183	. . . {being provided with a buffer layer, e.g. a lattice matching layer}
21/04	. by zone-melting		WARNING
21/06	. by pulling from a melt		This group is not complete pending reclassification; see also C30B 25/18 and subgroups
Single-crystal growth from vapours		25/186	. . . {being specially pre-treated by, e.g. chemical or physical means}
23/00	Single-crystal growth by condensing evaporated or sublimed materials	25/20	. . . the substrate being of the same materials as the epitaxial layer
	NOTE	25/205 {the substrate being of insulating material}
	Groups C30B 23/002 - C30B 23/005 take precedence over groups C30B 23/007 - C30B 23/08	25/22	. . Sandwich processes
	WARNING	27/00	Single-crystal growth under a protective fluid
	Group C30B 23/002 - C30B 23/005 are not complete, see also C30B 23/02	27/02	. by pulling from a melt
23/002	. {Controlling or regulating}	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 (alloys [C22C](#))

NOTE

In groups [C30B 29/02](#) - [C30B 29/58](#), in the absence of an indication to the contrary, a material is classified in the last appropriate place.

- 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
- 29/30 Niobates; Vanadates; Tantalates
- 29/32 Titanates; Germanates; Molybdates; Tungstates
- 29/34 . . Silicates
- 29/36 . . Carbides
- 29/38 . . Nitrides
- 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}
- 29/403 . . . { A_{III} -nitrides}
- 29/406 {Gallium nitride}
- 29/42 . . . Gallium arsenide
- 29/44 . . . Gallium phosphide
- 29/46 . . Sulfur-, selenium- or tellurium-containing compounds
- 29/48 . . . $A_{II}B_{VI}$ compounds {wherein A is Zn, Cd or Hg, and B is S, Se or Te}
- 29/50 Cadmium sulfide
- 29/52 . . Alloys
- 29/54 . Organic compounds
- 29/56 . . Tartrates
- 29/58 . . Macromolecular compounds
- 29/60 . characterised by shape
- 29/602 . . {Nanotubes}

- 29/605 . . {Products containing multiple oriented crystallites, e.g. columnar crystallites}
- 29/607 . . {Crystals of complex geometrical shape, e.g. tubes, cylinders ([nanotubes C30B 29/602](#))}

WARNING

Group [C30B 29/607](#) is not complete, see also [C30B 29/602](#), [C30B 29/605](#)

- 29/62 . . Whiskers or needles
- 29/64 . . Flat crystals, e.g. plates, strips or discs

WARNING

This group is not complete pending reclassification; see also [C30B 29/60](#) and subgroups

- 29/66 . . Crystals of complex geometrical shape, e.g. tubes, cylinders

WARNING

This group is not complete pending reclassification; see also [C30B 29/60](#) and subgroups

- 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 ([C30B 31/18 takes precedence](#))
- 31/08 . . the diffusion materials being a compound of the elements to be diffused
- 31/10 . . Reaction chambers; Selection of materials therefor
- 31/103 . . . {Mechanisms for moving either the charge or heater}
- 31/106 . . . {Continuous processes}
- 31/12 . Heating of the reaction chamber
- 31/14 . . Substrate holders or susceptors

- 31/16 . . Feed and outlet means for the gases; Modifying the flow of the gases
- 31/165 . . . {Diffusion sources}
- 31/18 . . Controlling or regulating ([controlling or regulating in general G05](#))
- 31/185 . . . {Pattern diffusion, e.g. by using masks}
- 31/20 . Doping by irradiation with electromagnetic waves or by particle radiation
- 31/22 . . by ion-implantation

33/00 **After-treatment of single crystals or homogeneous polycrystalline material with defined structure** ([C30B 31/00](#) takes precedence; grinding, polishing [B24](#); mechanical fine working of gems, jewels, crystals [B28D 5/00](#))

- 33/005 . {Oxydation}
- 33/02 . Heat treatment ([C30B 33/04](#), [C30B 33/06](#) take precedence)
- 33/04 . using electric or magnetic fields or particle radiation
- 33/06 . Joining of crystals
- 33/08 . Etching
- 33/10 . . in solutions or melts
- 33/12 . . in gas atmosphere or plasma

35/00 **Apparatus in general, specially adapted for the growth, production or after-treatment of single crystals or a homogeneous polycrystalline material with defined structure**

- 35/002 . {Crucibles or containers}
- 35/005 . {Transport systems}
- 35/007 . {Apparatus for preparing, pre-treating the source material to be used for crystal growth}

WARNING

This group is not complete pending reclassification; see also groups pertaining to the different crystal growth methods, particularly the main groups of subclass [C30B](#)