

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

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 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](#).
3. 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](#).

C30B 29/64, C30B 29/66 covered by C30B 29/60

- 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

7/14	<ul style="list-style-type: none"> the crystallising material being formed by chemical reactions in the solution 	13/16	<ul style="list-style-type: none"> 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	<ul style="list-style-type: none"> the heating element being in contact with, or immersed in, the molten zone
9/02	<ul style="list-style-type: none"> by evaporation of the molten solvent 	13/20	<ul style="list-style-type: none"> by induction, e.g. hot wire technique (C30B 13/18 takes precedence; induction coils H05B 6/36)
9/04	<ul style="list-style-type: none"> by cooling of the solution 	13/22	<ul style="list-style-type: none"> by irradiation or electric discharge
9/06	<ul style="list-style-type: none"> using as solvent a component of the crystal composition 	13/24	<ul style="list-style-type: none"> using electromagnetic waves
9/08	<ul style="list-style-type: none"> using other solvents 	13/26	<ul style="list-style-type: none"> Stirring of the molten zone
9/10	<ul style="list-style-type: none"> Metal solvents 	13/28	<ul style="list-style-type: none"> Controlling or regulating (controlling or regulating in general G05)
9/12	<ul style="list-style-type: none"> Salt solvents, e.g. flux growth 	13/285	<ul style="list-style-type: none"> {Crystal holders, e.g. chucks}
9/14	<ul style="list-style-type: none"> by electrolysis 	13/30	<ul style="list-style-type: none"> 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	<ul style="list-style-type: none"> Mechanisms for moving either the charge or the heater
11/001	<ul style="list-style-type: none"> {Continuous growth} 	13/34	<ul style="list-style-type: none"> characterised by the seed, e.g. by its crystallographic orientation
11/002	<ul style="list-style-type: none"> {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	<ul style="list-style-type: none"> {Heating or cooling of the melt or the crystallised material} 	15/002	<ul style="list-style-type: none"> {Continuous growth}
11/005	<ul style="list-style-type: none"> {by irradiation or electric discharge} 	15/005	<ul style="list-style-type: none"> {Simultaneous pulling of more than one crystal}
11/006	<ul style="list-style-type: none"> {Controlling or regulating} 	15/007	<ul style="list-style-type: none"> {Pulling on a substrate}
11/007	<ul style="list-style-type: none"> {Mechanisms for moving either the charge or the heater} 	15/02	<ul style="list-style-type: none"> adding crystallising material or reactants forming it <u>in situ</u> to the melt
11/008	<ul style="list-style-type: none"> {using centrifugal force to the charge} 	15/04	<ul style="list-style-type: none"> adding doping material, e.g. for n-p-junction
11/02	<ul style="list-style-type: none"> without using solvents (C30B 11/06 takes precedence) 	15/06	<ul style="list-style-type: none"> Non-vertical pulling
11/04	<ul style="list-style-type: none"> adding crystallising material or reactants forming it <u>in situ</u> to the melt 	15/08	<ul style="list-style-type: none"> Downward pulling
11/06	<ul style="list-style-type: none"> at least one but not all components of the crystal composition being added 	15/10	<ul style="list-style-type: none"> Crucibles or containers for supporting the melt
11/065	<ul style="list-style-type: none"> {before crystallising, e.g. synthesis} 	15/12	<ul style="list-style-type: none"> Double crucible methods
11/08	<ul style="list-style-type: none"> every component of the crystal composition being added during the crystallisation 	15/14	<ul style="list-style-type: none"> Heating of the melt or the crystallised material
11/10	<ul style="list-style-type: none"> Solid or liquid components, e.g. Verneuil method 	15/16	<ul style="list-style-type: none"> by irradiation or electric discharge
11/12	<ul style="list-style-type: none"> Vaporous components, e.g. vapour-liquid-solid-growth 	15/18	<ul style="list-style-type: none"> using direct resistance heating in addition to other methods of heating, e.g. using Peltier heat
11/14	<ul style="list-style-type: none"> characterised by the seed, e.g. its crystallographic orientation 	15/20	<ul style="list-style-type: none"> 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 ; zone-refining of specific materials, <u>see</u> the relevant subclasses for the materials)	15/203	<ul style="list-style-type: none"> {the relationship of pull rate (v) to axial thermal gradient (G)}
13/005	<ul style="list-style-type: none"> {Continuous growth} 	15/206	<ul style="list-style-type: none"> {the thermal history of growing the ingot}
13/02	<ul style="list-style-type: none"> Zone-melting with a solvent, e.g. travelling solvent process 	15/22	<ul style="list-style-type: none"> Stabilisation or shape controlling of the molten zone near the pulled crystal; Controlling the section of the crystal
13/04	<ul style="list-style-type: none"> Homogenisation by zone-levelling 	15/24	<ul style="list-style-type: none"> using mechanical means, e.g. shaping guides (shaping dies for edge-defined film-fed crystal growth C30B 15/34)
13/06	<ul style="list-style-type: none"> the molten zone not extending over the whole cross-section 	15/26	<ul style="list-style-type: none"> using television detectors; using photo or X-ray detectors
13/08	<ul style="list-style-type: none"> adding crystallising material or reactants forming it <u>in situ</u> to the molten zone 	15/28	<ul style="list-style-type: none"> using weight changes of the crystal or the melt, e.g. flotation methods
13/10	<ul style="list-style-type: none"> with addition of doping material 	15/30	<ul style="list-style-type: none"> Mechanisms for rotating or moving either the melt or the crystal (flotation methods C30B 15/28)
13/12	<ul style="list-style-type: none"> in the gaseous or vapour state 	15/305	<ul style="list-style-type: none"> {Stirring of the melt}
13/14	<ul style="list-style-type: none"> Crucibles or vessels 	15/32	<ul style="list-style-type: none"> Seed holders, e.g. chucks
		15/34	<ul style="list-style-type: none"> Edge-defined film-fed crystal-growth using dies or slits
		15/36	<ul style="list-style-type: none"> 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
- 19/04 . . the solvent being a component of the crystal composition
- 19/06 . Reaction chambers; Boats for supporting the melt; Substrate holders
- 19/061 . . {Tipping system, e.g. by rotation}
- 19/062 . . {Vertical dipping system}
- 19/063 . . {Sliding boat system}
- 19/064 . . {Rotating sliding boat system}
- 19/065 . . {Multiple stacked slider system}
- 19/066 . . {Injection or centrifugal force system}
- 19/067 . . {Boots or containers}
- 19/068 . . {Substrate holders}
- 19/08 . Heating of the reaction chamber or the substrate
- 19/10 . Controlling or regulating (controlling or regulating in general G05)
- 19/103 . . {Current controlled or induced growth}
- 19/106 . . {adding crystallising material or reactants forming it *in situ* to the liquid}
- 19/12 . characterised by the substrate
- 21/00 Unidirectional solidification of eutectic materials**
- 21/02 . by normal casting or gradient freezing
- 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 material****NOTE**

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

WARNING

Group [C30B 23/002](#) - [C30B 23/005](#) are not complete, see also [C30B 23/02](#)

- 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 material to be evaporated
- 23/063 . . . {Heating of the substrate}

WARNING

Group [C30B 23/063](#) is not complete, see also [C30B 23/06](#)

- 23/066 . . . {Heating of the material to be evaporated}

WARNING

Group [C30B 23/066](#) is not complete, see also [C30B 23/06](#)

- 23/08 . . by condensing ionised vapours (by reactive sputtering [C30B 25/06](#))

25/00**25/005****25/02****25/025****25/04****25/06****25/08****25/10****25/105****25/12****25/14****25/16****25/165****25/18****25/183****25/186****25/20****25/205****25/22****27/00****27/02****28/00****28/02****28/04****28/06****28/08****28/10****28/12****28/14****29/00****29/02****29/04****29/06****29/08****29/10****Single-crystal growth by chemical reaction of reactive gases, e.g. chemical vapour-deposition growth**

- . {Growth of whiskers or needles}
- . Epitaxial-layer growth
- . . {Continuous growth}
- . . Pattern deposit, e.g. by using masks
- . . by reactive sputtering
- . . Reaction chambers; Selection of material therefor
- . . Heating of the reaction chamber or the substrate
- . . . {by irradiation or electric discharge}
- . . Substrate holders or susceptors
- . . Feed and outlet means for the gases; Modifying the flow of the reactive gases
- . . Controlling or regulating (controlling or regulating in general G05)
- . . . {the flow of the reactive gases}

WARNING

Not complete pending reclassification, see also group [C30B 25/14](#)

- . . characterised by the substrate
- . . . {being provided with a buffer layer, e.g. a lattice matching layer}

WARNING

This group is not complete pending reclassification; see also [C30B 25/18](#) and subgroups

- . . . {being specially pre-treated by, e.g. chemical or physical means}
- . . . the substrate being of the same material as the epitaxial layer
- {the substrate being of insulating material}
- . . Sandwich processes

Single-crystal growth under a protective fluid

- . by pulling from a melt

Production of homogeneous polycrystalline material with defined structure

- . directly from the solid state
- . from liquids
- . . by normal freezing or freezing under temperature gradient
- . . by zone-melting
- . . by pulling from a melt
- . directly from the gas state
- . . by chemical reaction of reactive gases

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.

- . Elements
- . . Diamond
- . . Silicon
- . . Germanium
- . 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 material in the solid state
- 31/04 . by contacting with diffusion material 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 material being a compound of the elements to be diffused
- 31/10 . . Reaction chambers; Selection of material 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](#)