CPC COOPERATIVE PATENT CLASSIFICATION

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

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.

   Example: A crystal-growth process by zone-melting directly related to Al2O3 crystal material is classified in C30B 13/00 + C30B 29/20

WARNING

The following IPC groups are not used in the CPC system. Subject matter covered by these 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

C30B 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)

C30B 1/02 . by thermal treatment, e.g. strain annealing (C30B 1/12 takes precedence)

C30B 1/023 . . {from solids with amorphous structure}

C30B 1/026 . . {Solid phase epitaxial growth through a disordered intermediate layer}

C30B 1/04 . . Isothermal recrystallisation

C30B 1/06 . . Recrystallisation under a temperature gradient

C30B 1/08 . . . Zone recrystallisation

C30B 1/10 . by solid state reactions or multi-phase diffusion

C30B 1/12 . by pressure treatment during the growth

C30B 3/00 **Unidirectional demixing of eutectoid materials**

C30B 5/00 **Single-crystal growth from gels** (under a protective fluid C30B 27/00)

C30B 5/02 . with addition of doping material

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

C30B 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)

C30B 7/005 . {Epitaxial layer growth}

WARNING

Group C30B 7/005 is not complete, see also C30B 7/00

C30B 7/02 . by evaporation of the solvent

C30B 7/04 . . using aqueous solvents

C30B 7/06 . . using non-aqueous solvents

C30B 7/08 . by cooling of the solution

C30B 7/10 . by application of pressure, e.g. hydrothermal processes

C30B 7/105 . . {using ammonia as solvent, i.e. ammonothermal processes}

C30B 7/12 . by electrolysis

C30B 7/14 . the crystallising material being formed by chemical reactions in the solution

C30B 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)

C30B 9/02 . by evaporation of the molten solvent

C30B 9/04 . by cooling of the solution

C30B 9/06 . . using as solvent a component of the crystal composition

C30B 9/08 . . using other solvents
C30B 9/10 . . . Metal solvents
C30B 9/12 . . . Salt solvents, e.g. flux growth
C30B 9/14 . by electrolysis

C30B 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)

C30B 11/001 . {Continuous growth}
C30B 11/002 . {Crucibles or containers for supporting the melt}
C30B 11/003 . {Heating or cooling of the melt or the crystallised material}
C30B 11/005 . {by irradiation or electric discharge}
C30B 11/006 . {Controlling or regulating}
C30B 11/007 . {Mechanisms for moving either the charge or the heater}
C30B 11/008 . {using centrifugal force to the charge}
C30B 11/02 . without using solvents (C30B 11/06 takes precedence)
C30B 11/04 . adding crystallising material or reactants forming it in situ to the melt
C30B 11/06 . . at least one but not all components of the crystal composition being added
C30B 11/065 . . . {before crystallising, e.g. synthesis}
C30B 11/08 . . every component of the crystal composition being added during the crystallisation
C30B 11/10 . . . Solid or liquid components, e.g. Verneuil method
C30B 11/12 . . . Vaporous components, e.g. vapour-liquid-solid-growth
C30B 11/14 . characterised by the seed, e.g. its crystallographic orientation

C30B 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)

C30B 13/005 . {Continuous growth}
C30B 13/02 . Zone-melting with a solvent, e.g. travelling solvent process
C30B 13/04 . Homogenisation by zone-levelling
C30B 13/06 . the molten zone not extending over the whole cross-section
C30B 13/08 . adding crystallising material or reactants forming it in situ to the molten zone
C30B 13/10 . . with addition of doping material
C30B 13/12 . . . in the gaseous or vapour state
C30B 13/14 . Crucibles or vessels
C30B 13/16 . Heating of the molten zone
C30B 13/18 . . the heating element being in contact with, or immersed in, the molten zone
C30B 13/20 . . by induction, e.g. hot wire technique (C30B 13/18 takes precedence; induction coils H05B 6/36)
C30B 13/22 . . by irradiation or electric discharge
C30B 13/24 . . . using electromagnetic waves

C30B 13/26 . Stirring of the molten zone

C30B 13/28 . Controlling or regulating (controlling or regulating in general G05)

C30B 13/285 . . {Crystal holders, e.g. chucks}

C30B 13/30 . . Stabilisation or shape controlling of the molten zone, e.g. by concentrators, by electromagnetic fields; Controlling the section of the crystal

C30B 13/32 . Mechanisms for moving either the charge or the heater

C30B 13/34 . characterised by the seed, e.g. by its crystallographic orientation

C30B 15/00 **Single-crystal growth by pulling from a melt, e.g. Czochralski method** (under a protective fluid C30B 27/00)

C30B 15/002 . {Continuous growth}

C30B 15/005 . {Simultaneous pulling of more than one crystal}

C30B 15/007 . {Pulling on a substrate}

C30B 15/02 . adding crystallising material or reactants forming it in situ to the melt

C30B 15/04 . . adding doping material, e.g. for n-p-junction

C30B 15/06 . Non-vertical pulling

C30B 15/08 . Downward pulling

C30B 15/10 . Crucibles or containers for supporting the melt

C30B 15/12 . . Double crucible methods

C30B 15/14 . Heating of the melt or the crystallised material

C30B 15/16 . . by irradiation or electric discharge

C30B 15/18 . . using direct resistance heating in addition to other methods of heating, e.g. using Peltier heat

C30B 15/20 . Controlling or regulating (controlling or regulating in general G05)

C30B 15/203 . . {the relationship of pull rate (v) to axial thermal gradient (G)}

C30B 15/206 . . {the thermal history of growing the ingot}

C30B 15/22 . . Stabilisation or shape controlling of the molten zone near the pulled crystal; Controlling the section of the crystal

C30B 15/24 . . . using mechanical means, e.g. shaping guides (shaping dies for edge-defined film-fed crystal growth C30B 15/34)

C30B 15/26 . . . using television detectors; using photo or X-ray detectors

C30B 15/28 . . . using weight changes of the crystal or the melt, e.g. flotation methods

C30B 15/30 . Mechanisms for rotating or moving either the melt or the crystal (flotation methods C30B 15/28)

C30B 15/305 . . {Stirring of the melt}

C30B 15/32 . Seed holders, e.g. chucks

C30B 15/34 . Edge-defined film-fed crystal-growth using dies or slits

C30B 15/36 . characterised by the seed, e.g. its crystallographic orientation

C30B 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)

C30B 19/00 **Liquid-phase epitaxial-layer growth**

C30B 19/02 . using molten solvents, e.g. flux
C30B 19/04 . . the solvent being a component of the crystal composition
C30B 19/06 . Reaction chambers; Boats for supporting the melt; Substrate holders
C30B 19/061 . . {Tipping system, e.g. by rotation}
C30B 19/062 . . {Vertical dipping system}
C30B 19/063 . . {Sliding boat system}
C30B 19/064 . . {Rotating sliding boat system}
C30B 19/065 . . {Multiple stacked slider system}
C30B 19/066 . . {Injection or centrifugal force system}
C30B 19/067 . . {Boots or containers}
C30B 19/068 . . {Substrate holders}
C30B 19/08 . Heating of the reaction chamber or the substrate
C30B 19/10 . Controlling or regulating (controlling or regulating in general G05)
C30B 19/103 . . {Current controlled or induced growth}
C30B 19/106 . . {adding crystallising material or reactants forming it in situ to the liquid}
C30B 19/12 . characterised by the substrate

C30B 21/00 **Unidirectional solidification of eutectic materials**
C30B 21/02 . by normal casting or gradient freezing
C30B 21/04 . by zone-melting
C30B 21/06 . by pulling from a melt

Single-crystal growth from vapours

C30B 23/00 **Single-crystal growth by condensing evaporated or sublimed material**

NOTE

Groups C30B 23/002 - C30B 23/005 take precence over groups C30B 23/007 - C30B 23/08

WARNING

Group C30B 23/002 - C30B 23/005 are not complete, see also C30B 23/02

C30B 23/002 . {Controlling or regulating}
C30B 23/005 . . {Controlling or regulating flux or flow of depositing species or vapour}
C30B 23/007 . {Growth of whiskers or needles}
C30B 23/02 . Epitaxial-layer growth
C30B 23/025 . . {characterised by the substrate}
C30B 23/04 . . Pattern deposit, e.g. by using masks
C30B 23/06 . . Heating of the deposition chamber, the substrate or the material to be evaporated

C30B 23/063 . . . {Heating of the substrate}

WARNING

Group C30B 23/063 is not complete, see also C30B 23/06

C30B 23/066 . . . {Heating of the material to be evaporated}

WARNING

Group C30B 23/066 is not complete, see also C30B 23/06

C30B 23/08 . . by condensing ionised vapours (by reactive sputtering C30B 25/06)

C30B 25/00 Single-crystal growth by chemical reaction of reactive gases, e.g. chemical vapour-deposition growth

C30B 25/005 . {Growth of whiskers or needles}

C30B 25/02 . Epitaxial-layer growth

C30B 25/025 . . {Continuous growth}

C30B 25/04 . . Pattern deposit, e.g. by using masks

C30B 25/06 . . by reactive sputtering

C30B 25/08 . . Reaction chambers; Selection of material therefor

C30B 25/10 . . Heating of the reaction chamber or the substrate

C30B 25/105 . . . {by irradiation or electric discharge}

C30B 25/12 . . Substrate holders or susceptors

C30B 25/14 . . Feed and outlet means for the gases; Modifying the flow of the reactive gases

C30B 25/16 . . Controlling or regulating (controlling or regulating in general G05)

C30B 25/165 . . . {the flow of the reactive gases}

WARNING

Not complete pending reclassification, see also group C30B 25/14

C30B 25/18 . . characterised by the substrate

C30B 25/183 . . . {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

C30B 25/186 . . . {being specially pre-treated by e.g. chemical or physical means}

C30B 25/20 . . . the substrate being of the same material as the epitaxial layer

C30B 25/205 . . . . {the substrate being of insulating material}

C30B 25/22 . . Sandwich processes

C30B 27/00 Single-crystal growth under a protective fluid

C30B 27/02 . by pulling from a melt

C30B 28/00 Production of homogeneous polycrystalline material with defined structure

C30B 28/02 . directly from the solid state

C30B 28/04 . from liquids
C30B 28/06 . . by normal freezing or freezing under temperature gradient
C30B 28/08 . . by zone-melting
C30B 28/10 . . by pulling from a melt
C30B 28/12 . directly from the gas state
C30B 28/14 . . by chemical reaction of reactive gases

C30B 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.

C30B 29/02 . Elements
C30B 29/04 . . Diamond
C30B 29/06 . . Silicon
C30B 29/08 . . Germanium
C30B 29/10 . Inorganic compounds or compositions
C30B 29/12 . . Halides
C30B 29/14 . . Phosphates
C30B 29/16 . . Oxides
C30B 29/18 . . . Quartz
C30B 29/20 . . . Aluminium oxides
C30B 29/22 . . . Complex oxides
C30B 29/225 . . . . {based on rare earth copper oxides, e.g. high T-superconductors}
C30B 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
C30B 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
C30B 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
C30B 29/30 . . . . Niobates; Vanadates; Tantalates
C30B 29/32 . . . . Titanates; Germanates; Molybdates; Tungstates
C30B 29/34 . . Silicates
C30B 29/36 . . Carbides
C30B 29/38 . . Nitrides
C30B 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}
C30B 29/403 . . . {A_{III}-nitrides}
C30B 29/406 . . . . {Gallium nitride}
C30B 29/42 . . . Gallium arsenide
C30B 29/44 . . . Gallium phosphide

C30B 29/46 . . Sulfur-, selenium- or tellurium-containing compounds

C30B 29/48 . . . $A_{II}B_{VI}$ compounds {wherein A is Zn, Cd or Hg, and B is S, Se or Te}

C30B 29/50 . . . . Cadmium sulfide

C30B 29/52 . . Alloys

C30B 29/54 . Organic compounds

C30B 29/56 . . Tartrates

C30B 29/58 . . Macromolecular compounds

C30B 29/60 . characterised by shape

C30B 29/602 . . {Nanotubes}

C30B 29/605 . . {Products containing multiple oriented crystallites, e.g. columnar crystallites}

C30B 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

C30B 29/62 . . Whiskers or needles

C30B 29/64 . . Flat crystals, e.g. plates, strips, disks

WARNING

This group is not complete pending reclassification; see also C30B 29/60 and subgroups

C30B 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

C30B 29/68 . . Crystals with laminate structure, e.g. "superlattices"

C30B 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.

C30B 30/02 . using electric fields, e.g. electrolysis

C30B 30/04 . using magnetic fields

C30B 30/06 . using mechanical vibrations

C30B 30/08 . in conditions of zero-gravity or low gravity

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

C30B 31/00	**Diffusion or doping processes for single crystals or homogeneous polycrystalline material with defined structure; Apparatus therefor**
C30B 31/02	. by contacting with diffusion material in the solid state
C30B 31/04	. by contacting with diffusion material in the liquid state
C30B 31/045	. . {by electrolysis}
C30B 31/06	. by contacting with diffusion material in the gaseous state (C30B 31/18 takes precedence)
C30B 31/08	. . the diffusion material being a compound of the elements to be diffused
C30B 31/10	. . Reaction chambers; Selection of material therefor
C30B 31/103	. . . {Mechanisms for moving either the charge or heater}
C30B 31/106	. . . {Continuous processes}
C30B 31/12	. . Heating of the reaction chamber
C30B 31/14	. . Substrate holders or susceptors
C30B 31/16	. . Feed and outlet means for the gases; Modifying the flow of the gases
C30B 31/165	. . . {Diffusion sources}
C30B 31/18	. . Controlling or regulating (controlling or regulating in general G05)
C30B 31/185	. . . {Pattern diffusion, e.g. by using masks}
C30B 31/20	. Doping by irradiation with electromagnetic waves or by particle radiation
C30B 31/22	. . by ion-implantation
C30B 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)
C30B 33/005	. {Oxydation}
C30B 33/02	. Heat treatment (C30B 33/04, C30B 33/06 take precedence)
C30B 33/04	. using electric or magnetic fields or particle radiation
C30B 33/06	. Joining of crystals
C30B 33/08	. Etching
C30B 33/10	. . in solutions or melts
C30B 33/12	. . in gas atmosphere or plasma
C30B 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**
C30B 35/002	. {Crucibles or containers}
C30B 35/005	. {Transport systems}

C30B 35/007 . {Apparatus for preparing, pre-treating the source material tio 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