ECLA EUROPEAN CLASSIFICATION

C30B SINGLE-CRYSTAL-GROWTH (by using ultra-high pressure, e.g. for the formation of diamonds B01J3/06); 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

[N: **WARNING**
[C0506]

1.
2. The following IPC groups are not used in the internal ECLA classification system. Subject matter covered by these groups is classified in the following ECLA groups:

C30B29/64, C30B29/66 covered by C30B29/60

]

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 C30B29/00;
- 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 C30B35/00.

[N: **Notes**

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 C30B29/00.

Example: A crystal-growth process by zone-melting directly related to Al2O3 crystal material is classified in C30B13/00 + C30B29/20

]

Guide heading: **Single-crystal growth from solids or gels**

C30B1/00 **Single-crystal growth directly from the solid state** (unidirectional demixing of eutectoid materials C30B3/00; under a protective fluid C30B27/00)

C30B1/02 . by thermal treatment, e.g. strain annealing (C30B1/12 takes precedence)

C30B1/02B . . [N: from solids with amorphous structure]

C30B1/02D . . [N: Solid phase epitaxial growth through a disordered intermediate layer]

C30B1/04 . . Isothermal recrystallisation

C30B1/06 . . Recrystallisation under a temperature gradient

C30B1/08 . . . Zone recrystallisation

C30B1/10 . by solid state reactions or multi-phase diffusion

C30B1/12 . by pressure treatment during the growth

C30B3/00 **Unidirectional demixing of eutectoid materials**

C30B5/00 **Single-crystal growth from gels** (under a protective fluid C30B27/00)

C30B5/02 . with addition of doping material

Guide heading: **Single-crystal growth from liquids; Unidirectional solidification of eutectic materials**

C30B7/00 **Single-crystal growth from solutions using solvents which are liquid at normal temperature, e.g. aqueous solutions** (from molten solvents C30B9/00; by normal or gradient freezing C30B11/00; under a protective fluid C30B27/00)

C30B7/00B . [N: Epitaxial layer growth] [N0801]

[N: **WARNING** [N0801]
Group C30B7/00B is not complete, see also C30B7/00
]

C30B7/02 . by evaporation of the solvent

C30B7/04 . . using aqueous solvents
C30B7/06 . . using non-aqueous solvents

C30B7/08 . by cooling of the solution

C30B7/10 . by application of pressure, e.g. hydrothermal processes
C30B7/10B . . [N: using ammonia as solvent, i.e. ammonothermal processes] [N1012]

C30B7/12 . by electrolysis

C30B7/14 . the crystallising material being formed by chemical reactions in the solution

C30B9/00 **Single-crystal growth from melt solutions using molten solvents** (by normal or gradient freezing C30B11/00; by zone-melting C30B13/00; by crystal pulling C30B15/00; on immersed seed crystal C30B17/00; by liquid phase epitaxial growth C30B19/00; under a protective fluid C30B27/00)

C30B9/02 . by evaporation of the molten solvent

C30B9/04 . by cooling of the solution
C30B9/06 . . using as solvent a component of the crystal composition
C30B9/08 . . using other solvents
C30B9/10 . . . Metal solvents
C30B9/12 . . . Salt solvents, e.g. flux growth

C30B9/14 . by electrolysis

C30B11/00 **Single-crystal growth by normal freezing or freezing under temperature gradient, e.g. Bridgman-Stockbarger method** (C30B13/00, C30B15/00, C30B17/00, C30B19/00 take precedence; under a protective fluid C30B27/00)

C30B11/00B . [N: Continuous growth]

C30B11/00D . [N: Crucibles or containers for supporting the melt]

C30B11/00F . [N: Heating or cooling of the melt or the crystallised material]

C30B11/00G . [N: by irradiation or electric discharge]

C30B11/00H . [N: Controlling or regulating]

C30B11/00J . [N: Mechanisms for moving either the charge or the heater]

C30B11/00K . [N: using centrifugal force to the charge]

C30B11/02 . without using solvents (C30B11/06 takes precedence)

C30B11/04 . adding crystallising material or reactants forming it in situ to the melt
C30B11/06 . . at least one but not all components of the crystal composition being added

C30B11/06B . . . [N: before crystallising, e.g. synthesis]
C30B11/08 . . every component of the crystal composition being added during the crystallisation
C30B11/10 . . . Solid or liquid components, e.g. Verneuil method
C30B11/12 . . . Vaporous components, e.g. vapour-liquid-solid-growth

C30B11/14 . characterised by the seed, e.g. its crystallographic orientation

C30B13/00 **Single-crystal growth by zone-melting; Refining by zone-melting** (C30B17/00 takes precedence; by changing the cross-section of the treated solid C30B15/00; under a protective fluid C30B27/00; zone-refining of specific materials, see the relevant subclasses for the materials)

C30B13/00B . [N: Continuous growth]

C30B13/02 . Zone-melting with a solvent, e.g. travelling solvent process

C30B13/04 . Homogenisation by zone-levelling

C30B13/06 . the molten zone not extending over the whole cross-section

C30B13/08 . adding crystallising material or reactants forming it in situ to the molten zone
C30B13/10 . . with addition of doping material
C30B13/12 . . . in the gaseous or vapour state

C30B13/14 . Crucibles or vessels

C30B13/16 . Heating of the molten zone
C30B13/18 . . the heating element being in contact with, or immersed in, the molten zone
C30B13/20 . . by induction, e.g. hot wire technique (C30B13/18 takes precedence; induction coils H05B6/36)
C30B13/22 . . by irradiation or electric discharge
C30B13/24 . . . using electromagnetic waves

C30B13/26 . Stirring of the molten zone

C30B13/28 . Controlling or regulating (controlling or regulating in general G05)
C30B13/28B . . [N: Crystal holders, e.g. chucks]
C30B13/30 . . Stabilisation or shape controlling of the molten zone, e.g. by concentrators, by electromagnetic fields; Controlling the section of the crystal

C30B13/32 . Mechanisms for moving either the charge or the heater

C30B13/34 . characterised by the seed, e.g. by its crystallographic orientation

C30B15/00 **Single-crystal growth by pulling from a melt, e.g. Czochralski method** (under a protective fluid C30B27/00)

C30B15/00B . [N: Continuous growth]

C30B15/00D . [N: Simultaneous pulling of more than one crystal]

C30B15/00F . [N: Pulling on a substrate]

C30B15/02 . adding crystallising material or reactants forming it in situ to the melt

C30B15/04 . . adding doping material, e.g. for n-p-junction

C30B15/06 . Non-vertical pulling

C30B15/08 . Downward pulling

C30B15/10 . Crucibles or containers for supporting the melt

C30B15/12 . . Double crucible methods

C30B15/14 . Heating of the melt or the crystallised material

C30B15/16 . . by irradiation or electric discharge

C30B15/18 . . using direct resistance heating in addition to other methods of heating, e.g. using Peltier heat

C30B15/20 . Controlling or regulating (controlling or regulating in general G05)

C30B15/20B . . [N: the relationship of pull rate (v) to axial thermal gradient (G)] [N0801]

C30B15/20C . . [N: the thermal history of growing the ingot] [N0801]

C30B15/22 . . Stabilisation or shape controlling of the molten zone near the pulled crystal; Controlling the section of the crystal

C30B15/24 . . . using mechanical means, e.g. shaping guides (shaping dies for edge-defined film-fed crystal growth C30B15/34)

C30B15/26 . . . using television detectors; using photo or X-ray detectors

C30B15/28 . . . using weight changes of the crystal or the melt, e.g. flotation methods

C30B15/30 . Mechanisms for rotating or moving either the melt or the crystal (flotation methods C30B15/28)

C30B15/30B . . [N: Stirring of the melt]

C30B15/32 . Seed holders, e.g. chucks

C30B15/34 . Edge-defined film-fed crystal-growth using dies or slits

C30B15/36 . characterised by the seed, e.g. its crystallographic orientation

C30B17/00 **Single-crystal growth onto a seed which remains in the melt during growth, e.g. Nacken-Kyropoulos method** (C30B15/00 takes precedence)

C30B19/00 **Liquid-phase epitaxial-layer growth**

C30B19/02 . using molten solvents, e.g. flux

C30B19/04 . . the solvent being a component of the crystal composition

C30B19/06 . Reaction chambers; Boats for supporting the melt; Substrate holders

C30B19/06D . . [N: Tipping system, e.g. by rotation]
C30B19/06F . . [N: Vertical dipping system]
C30B19/06H . . [N: Sliding boat system]
C30B19/06I . . [N: Rotating sliding boat system]
C30B19/06J . . [N: Multiple stacked slider system]
C30B19/06K . . [N: Injection or centrifugal force system]
C30B19/06L . . [N: Boots or containers]
C30B19/06Q . . [N: Substrate holders]

C30B19/08 . Heating of the reaction chamber or the substrate

C30B19/10 . Controlling or regulating (controlling or regulating in general G05)
C30B19/10P . . [N: Current controlled or induced growth]
C30B19/10R . . [N: adding crystallising material or reactants forming it in situ to the liquid]

C30B19/12 . characterised by the substrate

C30B21/00 **Unidirectional solidification of eutectic materials**

C30B21/02 . by normal casting or gradient freezing

C30B21/04 . by zone-melting

C30B21/06 . by pulling from a melt

Guide heading: **Single-crystal growth from vapours**

C30B23/00 **Single-crystal growth by condensing evaporated or sublimed material**

[N: **Note** [N0801]
Groups C30B23/00C to C30B23/00D take precence over groups C30B23/00F to C30B23/08
]

[N: **WARNING** [N0801]
Group C30B23/00C to C30B23/00D are not complete, see also C30B23/02
]

C30B23/00C . [N: Controlling or regulating] [N0801]
C30B23/00C2 . . [N: Controlling or regulating flux or flow of depositing species or vapour] [N0801]

C30B23/00F . [N: Growth of whiskers or needles]

C30B23/02 . Epitaxial-layer growth
C30B23/02B . . [N: characterised by the substrate] [N1012]
C30B23/04 . . Pattern deposit, e.g. by using masks
C30B23/06 . . Heating of the deposition chamber, the substrate or the material to be evaporated

C30B23/06B . . . [N: Heating of the substrate] [N0801]

[N: **WARNING** [N0801]
Group C30B23/06B is not complete, see also C30B23/06
]

C30B23/06D . . . [N: Heating of the material to be evaporated] [N0801]

[N: **WARNING** [N0801]
Group C30B23/06D is not complete, see also C30B23/06
]

C30B23/08 . . by condensing ionised vapours (by reactive sputtering C30B25/06)

C30B25/00 **Single-crystal growth by chemical reaction of reactive gases, e.g. chemical vapour-deposition growth**

C30B25/00F . [N: Growth of whiskers or needles]

C30B25/02 . Epitaxial-layer growth
C30B25/02B . . [N: Continuous growth]
C30B25/04 . . Pattern deposit, e.g. by using masks
C30B25/06 . . by reactive sputtering
C30B25/08 . . Reaction chambers; Selection of material therefor
C30B25/10 . . Heating of the reaction chamber or the substrate
C30B25/10B . . . [N: by irradiation or electric discharge]
C30B25/12 . . Substrate holders or susceptors
C30B25/14 . . Feed and outlet means for the gases; Modifying the flow of the reactive gases
C30B25/16 . . Controlling or regulating (controlling or regulating in general G05)
C30B25/16B . . . [N: the flow of the reactive gases] [N1008]

[N: **WARNING** [N1008]
Not complete pending reclassification, see also group C30B25/14
]

C30B25/18 . . characterised by the substrate
C30B25/18B . . . [N: being provided with a buffer layer, e.g. a lattice matching layer] [N1012]

[N: **WARNING** [N1012]
This group is not complete pending reclassification; see also C30B25/18 and subgroups
]

C30B25/18D . . . [N: being specially pre-treated by e.g. chemical or physical means] [N1012]
C30B25/20 . . . the substrate being of the same material as the epitaxial layer
C30B25/20B . . . . [N: the substrate being of insulating material]
C30B25/22 . . Sandwich processes

C30B27/00 **Single-crystal growth under a protective fluid**

C30B27/02 . by pulling from a melt

C30B28/00 **Production of homogeneous polycrystalline material with defined structure** [N0102]

C30B28/02 . directly from the solid state [N0102]

C30B28/04 . from liquids [N0102]
C30B28/06 . . by normal freezing or freezing under temperature gradient [N0102]
C30B28/08 . . by zone-melting [N0102]
C30B28/10 . . by pulling from a melt [N0102]

C30B28/12 . directly from the gas state [N0102]
C30B28/14 . . by chemical reaction of reactive gases [N0102]

C30B29/00 **Single crystals or homogeneous polycrystalline material with defined structure characterised by the material or by their shape** (alloys C22C)

Note
In groups C30B29/02 to C30B29/58, in the absence of an indication to the contrary, a material is classified in the last appropriate place.

C30B29/02 . Elements
C30B29/04 . . Diamond
C30B29/06 . . Silicon
C30B29/08 . . Germanium

C30B29/10 . Inorganic compounds or compositions
C30B29/12 . . Halides
C30B29/14 . . Phosphates
C30B29/16 . . Oxides
C30B29/18 . . . Quartz
C30B29/20 . . . Aluminium oxides
C30B29/22 . . . Complex oxides
C30B29/22B . . . . [N: based on rare earth copper oxides, e.g. high T-superconductors] [N0801]
C30B29/24 . . . . with formula AMeO3, wherein A is a rare earth metal and Me is Fe, Ga, Sc, Cr, Co or Al, e.g. ortho ferrites
C30B29/26 . . . . with formula BMe2O4, wherein B is Mg, Ni, Co, Al, Zn, or Cd and Me is Fe, Ga, Sc, Cr, Co, or Al
C30B29/28 . . . . with formula A3Me5O12 wherein A is a rare earth metal and Me is Fe, Ga, Sc, Cr, Co or Al, e.g. garnets
C30B29/30 . . . . Niobates; Vanadates; Tantalates
C30B29/32 . . . . Titanates; Germanates; Molybdates; Tungstates
C30B29/34 . . Silicates
C30B29/36 . . Carbides
C30B29/38 . . Nitrides
C30B29/40 . . AIIIBV compounds [N: wherein A is B, Al, Ga, In or Tl and B is N, P, As, Sb or Bi]
C30B29/40B . . . AIII-nitrides [N0801]
C30B29/40B2 . . . . Gallium nitride [N0801]
C30B29/42 . . . Gallium arsenide

C30B29/44 . . . Gallium phosphide
C30B29/46 . . Sulfur-, selenium- or tellurium-containing compounds
C30B29/48 . . . AIIBVI compounds [N: wherein A is Zn, Cd or Hg, and B is S, Se or Te]
C30B29/50 . . . . Cadmium sulfide
C30B29/52 . . Alloys

C30B29/54 . Organic compounds
C30B29/56 . . Tartrates
C30B29/58 . . Macromolecular compounds

C30B29/60 . characterised by shape
C30B29/60B . . [N: Nanotubes] [C0801]
C30B29/60D . . [N: Products containing multiple oriented crystallites, e.g. columnar crystallites]
C30B29/60F . . [N: Crystals of complex geometrical shape, e.g. tubes, cylinders (nanotubes 29/60B) [N0801]

[N: **WARNING** [N0801]
Group C30B29/60F is not complete, see also C30B29/60B, C30B29/60D
]
C30B29/62 . . Whiskers or needles
C30B29/64 . . Flat crystals, e.g. plates, strips, disks [N1012]

[N: **WARNING** [N1012]
This group is not complete pending reclassification; see also C30B29/60 and subgroups
]
C30B29/66 . . Crystals of complex geometrical shape, e.g. tubes, cylinders [N1012]

[N: **WARNING** [N1012]
This group is not complete pending reclassification; see also C30B29/60 and subgroups
]
C30B29/68 . . Crystals with laminate structure, e.g. "superlattices"

C30B30/00 **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 C30B1/00 to C30B27/00 according to the process of crystal growth.

C30B30/02 . using electric fields, e.g. electrolysis [N9801]

C30B30/04 . using magnetic fields [N9801]

C30B30/06 . using mechanical vibrations [N9801]

C30B30/08 . in conditions of zero-gravity or low gravity

Guide heading: **After-treatment of single crystals or homogeneous polycrystalline material with defined structure**

C30B31/00 **Diffusion or doping processes for single crystals or homogeneous polycrystalline material with defined structure; Apparatus therefor**

C30B31/02 . by contacting with diffusion material in the solid state

C30B31/04 . by contacting with diffusion material in the liquid state

C30B31/04B . . [N: by electrolysis]

C30B31/06 . by contacting with diffusion material in the gaseous state (C30B31/18 takes precedence)

C30B31/08 . . the diffusion material being a compound of the elements to be diffused

C30B31/10 . . Reaction chambers; Selection of material therefor

C30B31/10B . . . [N: Mechanisms for moving either the charge or heater]

C30B31/10D . . . [N: Continuous processes]

C30B31/12 . . Heating of the reaction chamber

C30B31/14 . . Substrate holders or susceptors

C30B31/16 . . Feed and outlet means for the gases; Modifying the flow of the gases

C30B31/16B . . . [N: Diffusion sources]

C30B31/18 . . Controlling or regulating (controlling or regulating in general G05)

C30B31/18B . . . [N: Pattern diffusion, e.g. by using masks]

C30B31/20 . Doping by irradiation with electromagnetic waves or by particle radiation

C30B31/22 . . by ion-implantation

C30B33/00 **After-treatment of single crystals or homogeneous polycrystalline material with defined structure** (C30B31/00 takes precedence; grinding, polishing B24; mechanical fine working of gems, jewels, crystals B28D5/00)

C30B33/00B . [N: Oxydation]

C30B33/02 . Heat treatment (C30B33/04, C30B33/06 take precedence) [N0102]

C30B33/04 . using electric or magnetic fields or particle radiation [N0102]

C30B33/06 . Joining of crystals [N0102]

C30B33/08 . Etching [N0102]

C30B33/10 . . in solutions or melts [N0102]

C30B33/12 . . in gas atmosphere or plasma [N0102]

C30B35/00 **Apparatus in general, specially adapted for the growth, production or after-treatment of single crystals or a homogeneous polycrystalline material with defined structure**

C30B35/00B . [N: Crucibles or containers]

C30B35/00D . [N: Transport systems]

C30B35/00F . [N: Apparatus for preparing, pre-treating the source material tio be used for crystal growth] [N1012]

[N: **WARNING** [N1012]
This group is not complete pending reclassification; see also groups pertaining to the different crystal growth methods, particularly the main groups of subclass C30B
]