

**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**

**NOTE**

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<sub>2</sub>O<sub>3</sub> 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](#)

**Guidance heading: 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

**Guidance heading: 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

### **Guidance heading: Single-crystal growth from vapours**

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

#### **NOTE**

Groups [C30B 23/002](#) to [C30B 23/00D](#) take precedence over groups [C30B 23/007](#) to [C30B 23/08](#)

#### **WARNING**

Group [C30B 23/002](#) to [C30B 23/00D](#) 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](#) to [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 .. AlIBV compounds { wherein A is B, Al, Ga, In or Tl and B is N, P, As, Sb or Bi }
- C30B 29/403 ... AlIII-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 . . . AlIBVI 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 29/60B )

**WARNING**

Group [C30B 29/607](#) is not complete, see also [C30B 29/60B](#), [C30B 29/60D](#)

- 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](#) to [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

**Guidance heading:** 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 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](#)