



Diagramas de Fase

Permiten un prediseño de la experiencia

Permiten una explicación inicial de los resultados y/o indican los caminos para modificarlos

Los diagramas de fases pueden ser :

Temperatura - Composición (en general a p.atm.)

Temperatura - Presión

Presión - Composición

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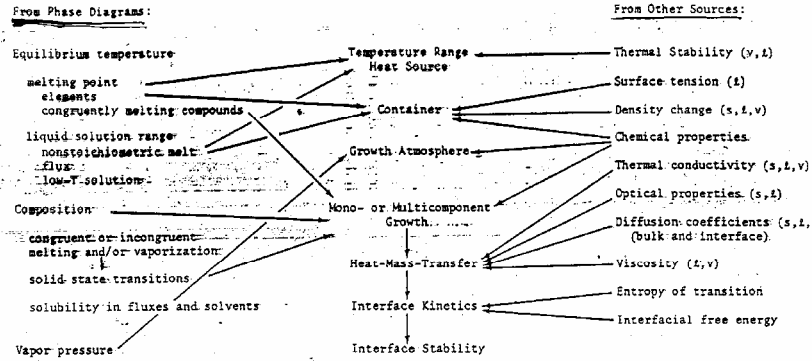


Fig. 4.1. Material parameters important for the selection of a crystal growth method, and their relation to growth meters (center column) (s: solid, l: liquid, v: vapor)

Disponibilidad

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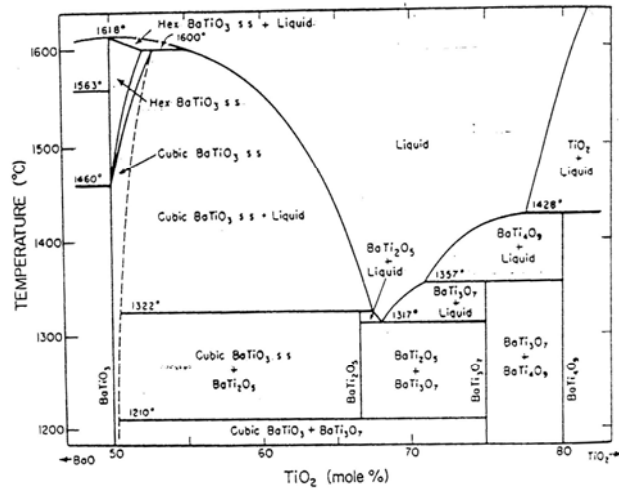


Fig.4.15. Section of phase diagram of BaO-TiO₂ system. From [4.14] by permission of Pergamon Press

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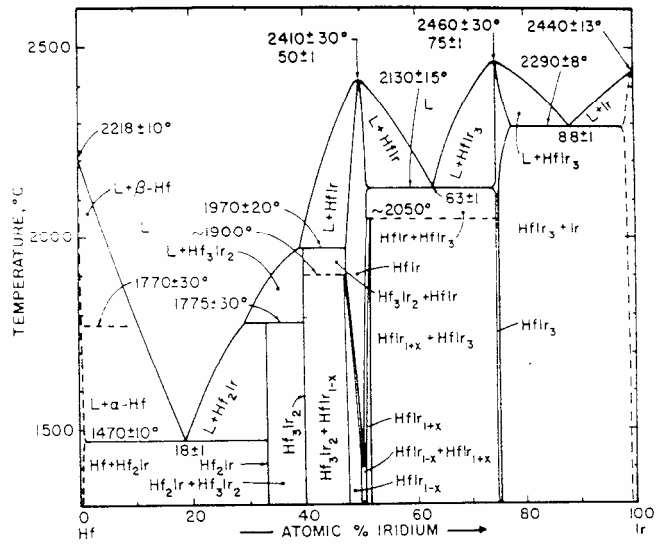


Figure 12. Phase diagram for the system Hf-Ir illustrating types of compounds (from Rudy, 1969).

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Simple Binary Phase Diagrams

W.B. White, *Phase equilibria*

The simplest binary system is one with complete miscibility in both liquid and solid phases.

Nickel and copper are examples of systems with complete miscibility in both liquid and solid phases.

Since copper and nickel are completely miscible in both liquid and solid phases, the phase diagram for the system is a simple one.

The binary phase diagram

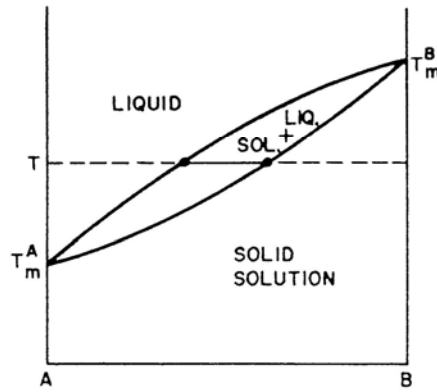


Figure 6. Schematic binary phase diagram for a system with complete miscibility in liquid and solid phases.

U → % Cu
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olid
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100



More Complex Phase Diagrams

W. B. White, *Phase equilibria*

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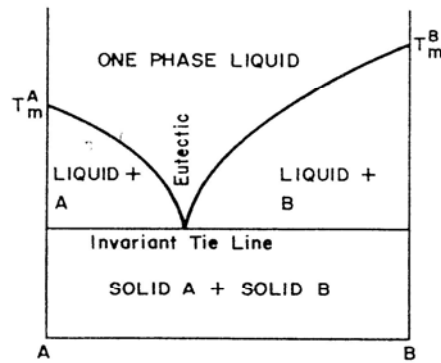
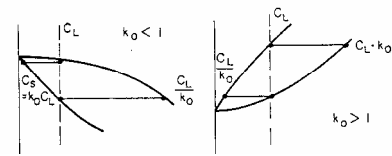


Figure 7. Schematic phase diagram for a system with complete miscibility in the liquid phase and complete immiscibility in the solid phase.

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Algunos casos significativos. Aplicaciones y consideraciones generales



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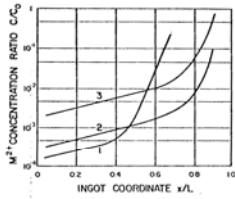


Fig.6.31. Impurity concentration profiles in zone refined KCl ingots. C_0 is the initial impurity level of about 1 ppm. After [6.50]. (1): Polycrystalline ingot. ($L = 28\text{cm}$, $l = 1\text{cm}$, $n = 20$). Higher purity in front part due to ultra-pure graphite container, lower purity in rear due to horizontal boat arrangement allowing for vapor transfer. (2): Single crystal. ($L = 16.5\text{cm}$, $l = 1.5\text{cm}$, $n = 23$). Somewhat lower purity in front from quartz container. Higher efficiency in rear from reduction of vapor transfer in vertical arrangement that is also more advantageous for single crystal growth. (3): Identical to (2) except for chlorine bubble formation at growing interface

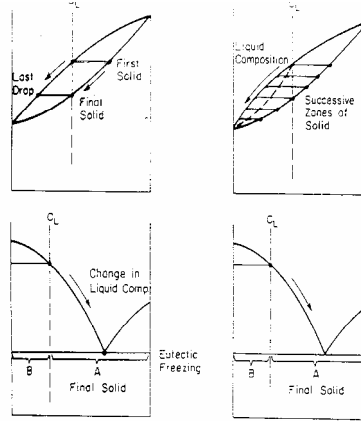


Figure 22. Schematic diagrams illustrating ideal equilibrium cooling and fractionation cooling. Arrows indicate direction of change of liquid composition.

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Algunos casos significativos. Aplicaciones y consideraciones generales

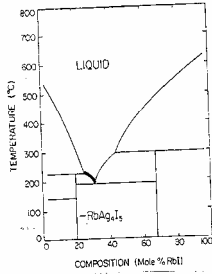


Fig.4.10. Phase diagram for the KCl-AgI system. After [4.11a]

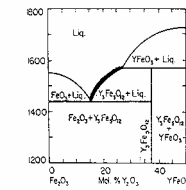


Fig.4.11. Partial phase diagram of the Fe_2O_3 - FeO system. From [4.3] by permission of Academic Press

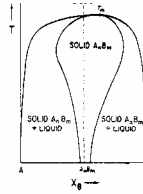


Fig.4.4. Schematic temperature-composition diagram for a compound-forming system A-B. Temperature dependence of the A_nB_n existence range

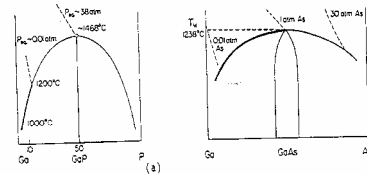


Fig.4.8. T-x projections of the phase figure for (a) the Ga-P system and (b) greatly expanded center portion of the Ga-As system. From [4.3] by permission of Academic Press

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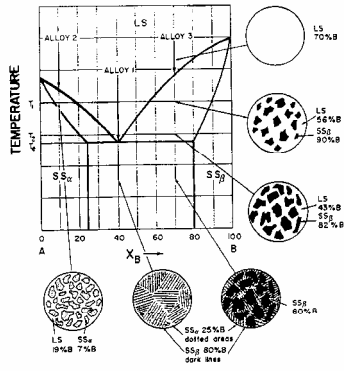


Fig.3.23. Three different solidification processes in a simplified eutectic system (solvus lines drawn vertically) and their structural results. (LS: liquid solution SS: solid solution)

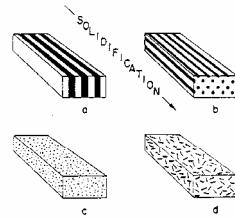


Fig.3.24. Schematic illustration of various eutectic structures: (a) lamellar; (b) rodlike; (c) globular (d) acicular. After [3.22]

equilibrium with a melt of 19% B in A. Their relative amounts follow from the lever rule, (3.25).

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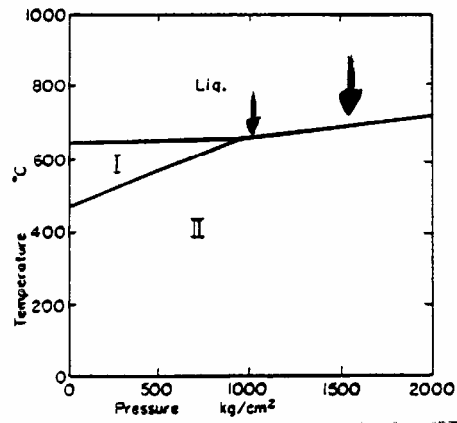


Fig.4.17. P-T phase diagram of CsCl. From [4.17] by permission of North Holland Publ. Co.

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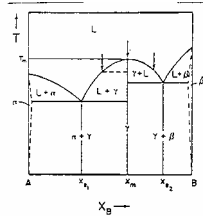


Fig. 3.34. Congruently melting compound (composition X_m) in binary phase diagram with two eutectics

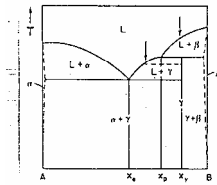
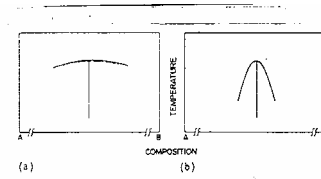


Fig. 3.35. Incongruently melting interme-



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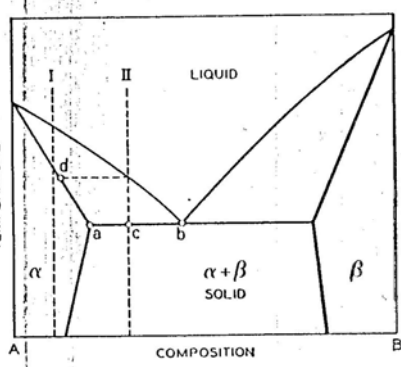


Fig. 6.32. Zone refining of eutectic. From [6.37] by permission of John Wiley and Sons

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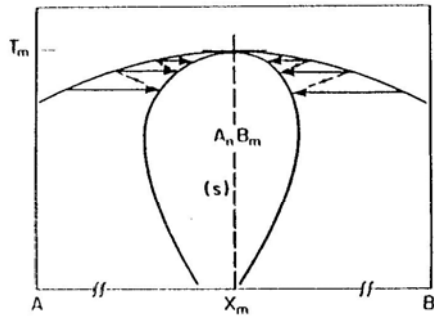


Fig.6.33. Expanded part of binary phase diagram with compound formation. Successive "purification" of off-stoichiometric material by zone melting

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Método de Bridgman

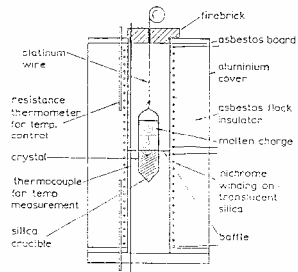


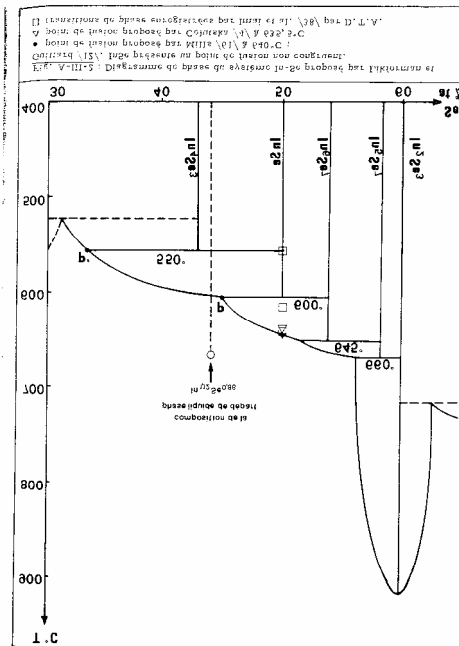
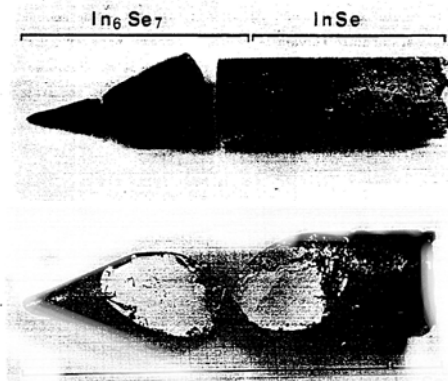
Fig. 1.1. The Bridgman technique. Apparatus of the type shown has been used with a wide range of materials with melting points up to about 1200 C. For higher melting materials, other crucibles and furnace windings can be used. Typical rates of lowering are in the range 5 to 100 mm hr⁻¹.



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Diagrama de fases del In-Se



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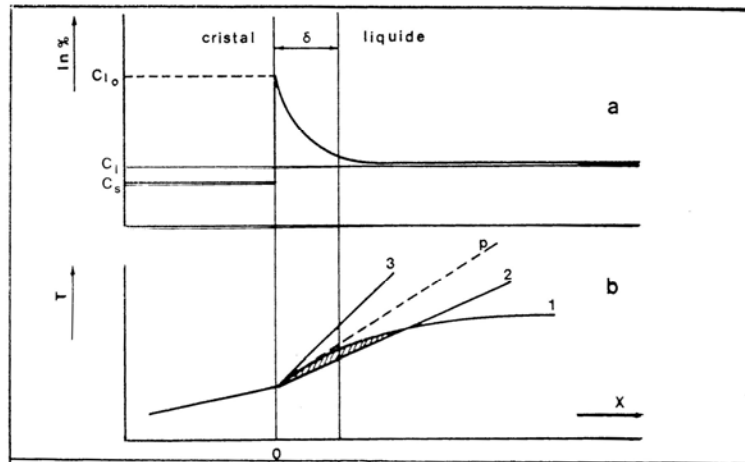
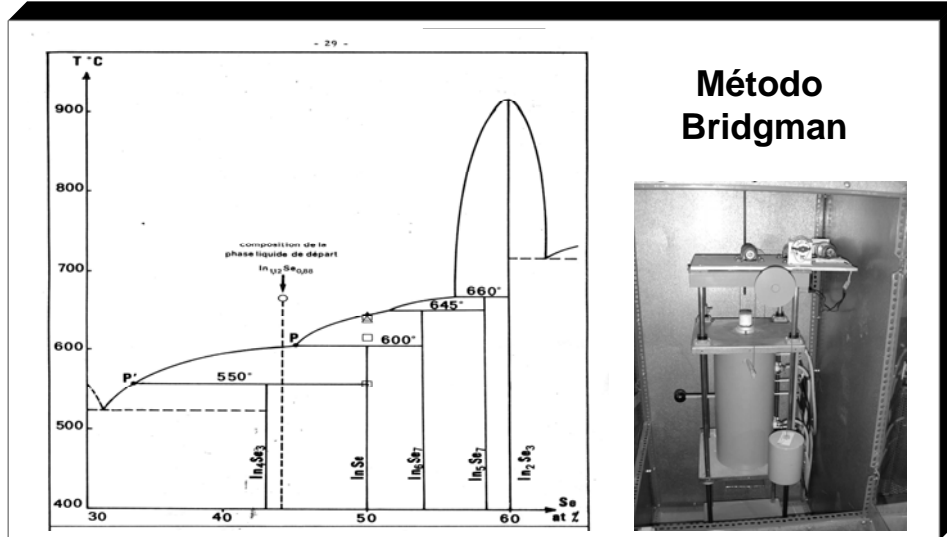


Fig. A-III-15 : Surfusion de constitution :
a - le rejet d'une impureté augmente la concentration de celle-ci au niveau de l'interface solide-liquide ;
b - l'existence de la couche limite peut placer le liquide en surfusion suivant la valeur du gradient thermique réel à l'interface.

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Semiconductores laminares III-VI






**Método
Bridgman**

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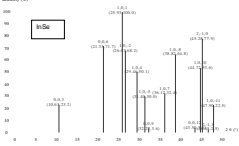
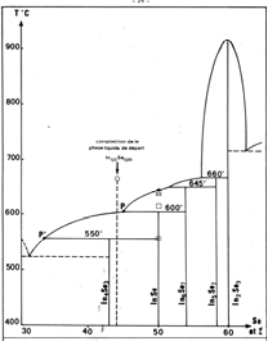
Semiconductores laminares III-VI

InSe



Método Bridgman





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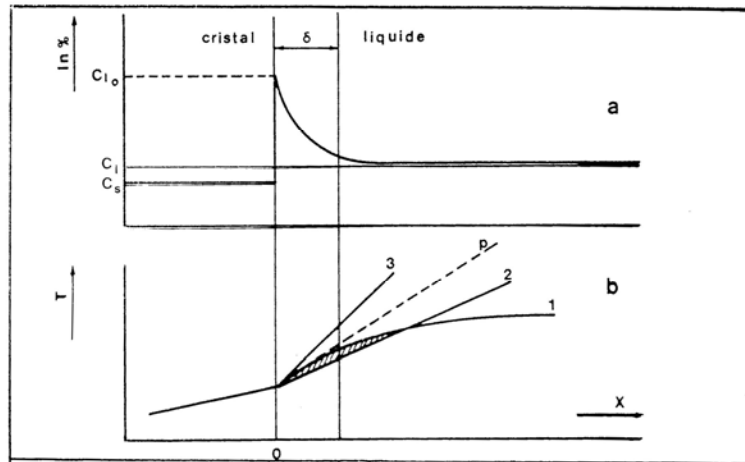


Fig. A-III-15 : Surfusión de constitución :
a - le rejet d'une impureté augmente la concentration de celle-ci au niveau de l'interface solide-liquide ;
b - l'existence de la couche limite peut placer le liquide en surfusion suivant la valeur du gradient thermique réel à l'interface.

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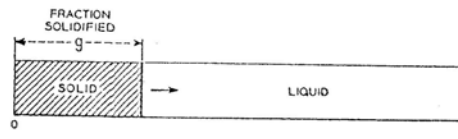


Fig.6.14. Solidification by normal freezing. From [6.37] by permission of John Wiley and Sons

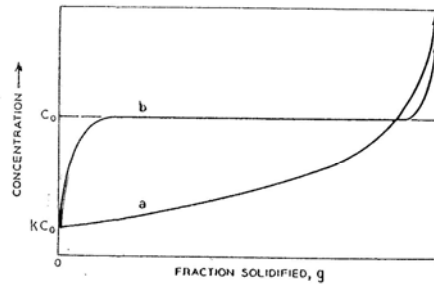


Fig.6.15. Concentration of solute after normal freezing versus fraction solidified for $k < 1$: (a) partial mixing in liquid, (b) transport in liquid by diffusion only. From [6.37] by permission of John Wiley and Sons

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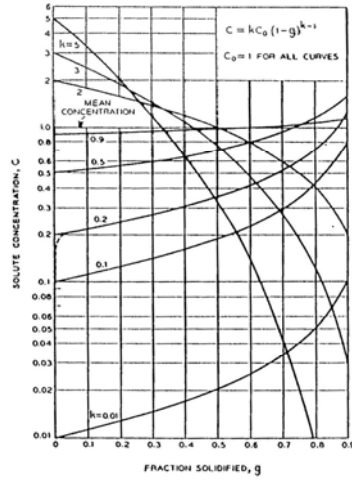


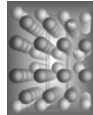
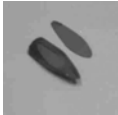
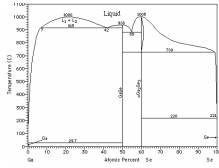
Fig.6.16. Concentration profiles in solid for normal freezing calculated from (6.45) for various effective segregation coefficients k . From [6.37] by permission of John Wiley and Sons

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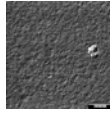
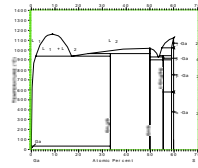


Semiconductores laminares III-VI

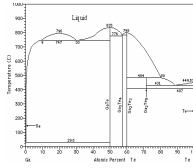
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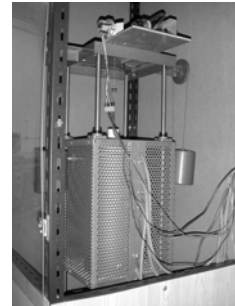
GaS



GaTe



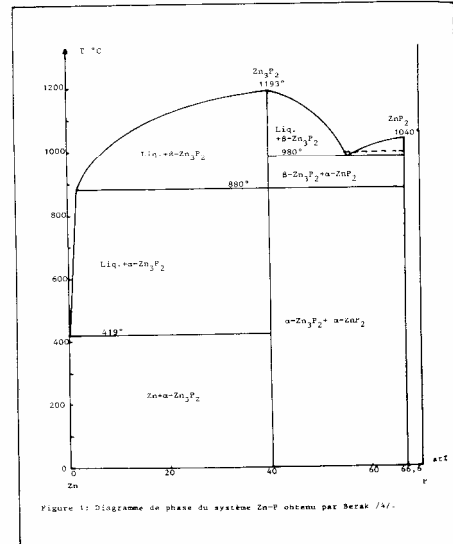
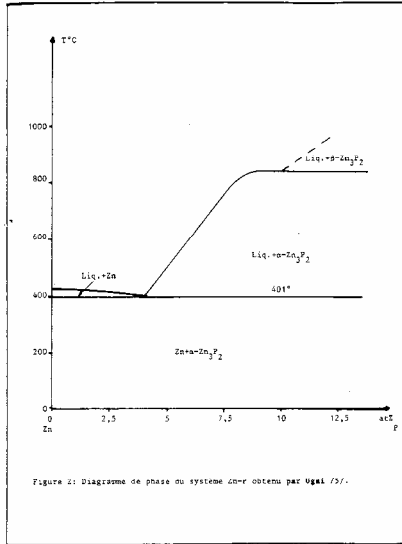
**Método
Bridgman**



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Diagrama de fases Zn-P



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Crecimiento cristalino y caracterización de materiales semiconductores

Phase diagram of Zn-P system showing temperature (°C) vs. Atomic Percent (Zn/P). Key features include the liquid phase (L), solid phases (Zn, P, Zn₃P₂), and reaction lines such as 1172.3, 840, 55, 100, 66, 4.12, and 1.27P.

Zn₃P₂

PVT

XRD pattern of Zn₃P₂ showing intensity (%) vs. 2θ (°). Key peaks are indexed to the Zn₃P₂ phase with Miller indices such as (011), (012), (013), (014), (015), (016), (017), (018), (019), (020), (021), (022), (023), (024), (025), (026), (027), (028), (029), (030), (031), (032), (033), (034), (035), (036), (037), (038), (039), (040), (041), (042), (043), (044), (045), (046), (047), (048), (049), (050), (051), (052), (053), (054), (055), (056), (057), (058), (059), (060), (061), (062), (063), (064), (065), (066), (067), (068), (069), (070), (071), (072), (073), (074), (075), (076), (077), (078), (079), (080), (081), (082), (083), (084), (085), (086), (087), (088), (089), (090), (091), (092), (093), (094), (095), (096), (097), (098), (099), (100), (101), (102), (103), (104), (105), (106), (107), (108), (109), (110), (111), (112), (113), (114), (115), (116), (117), (118), (119), (120), (121), (122), (123), (124), (125), (126), (127), (128), (129), (130), (131), (132), (133), (134), (135), (136), (137), (138), (139), (140), (141), (142), (143), 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Bridgman no estequiométrico

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Diagrama de fases Cd-Te

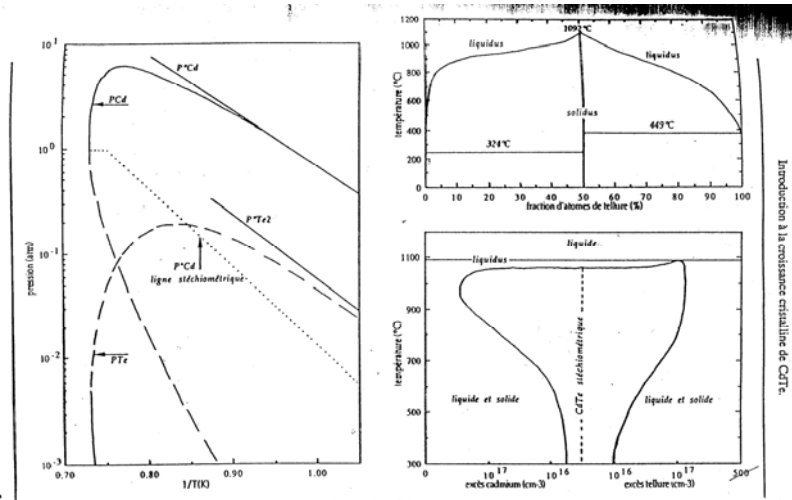


Fig 1.1: diagrammes de phase du tellure de cadmium
 a diagramme pression-température entre les trois phases solide-liquide vapeur (nous y avons représenté la pression de cadmium correspondant à un équilibre entre la vapeur et le CdTe solide stœchiométrique).
 b.c. diagrammes composition-température (d'après K.Zanin ref 2. page 3).

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Diagrama de fases Cd-Te

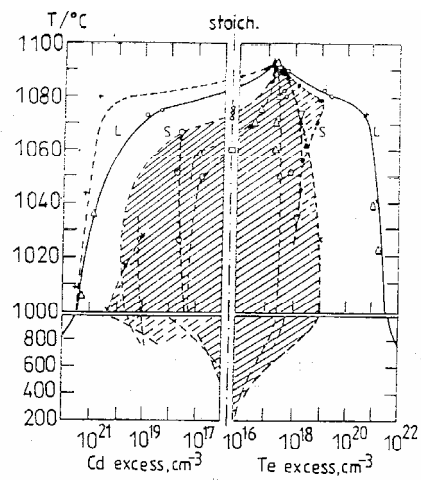


Fig.2.2. The homogeneity region of CdTe in the T- γ projection near the melt temperature and below 1000°C (The data are taken from Ref.[6,7,24,35,105] and Ivanov (o) [private communication 1993])

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Diagrama de fases Cd-Te

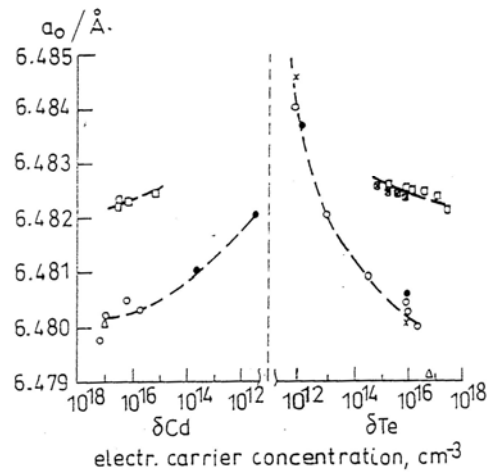


Fig.2.3. The composition dependence of the CdTe lattice parameter a , taken from Kalushnaja and Kiseleva [36] (○●), Song Wen-Bin *et al.*[40] (x) and Wienecke *et al.*[35] (□)

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Diagrama de fases Cd-Te

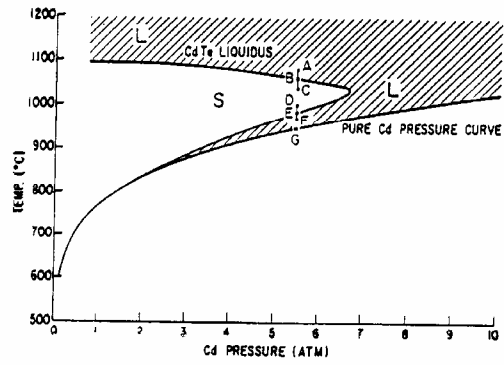


Fig.4.18. T-P projection of the "Cd-rich half" of the Cd-Te system. From [4.18] by permission of the American Institute of Physics

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Materiales II-VI

CdTe

Método Bridgman

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