Improving CdTe and CdZnTe Crystals by Agitation during the Crystal Growth

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DOI: 10.13140/RG.2.2.18676.76168

Abstract
Ampoule agitation during Bridgman crystal growth of CdTe and CdZnTe, and of similar materials, is proposed to improve the uniformity and other properties of the crystals.

Crystals are classically grown by rotating a solid seed in a liquid melt in order to have crystals with uniform properties.
Crystal growth by the Bridgmann method takes place in a closed ampoule in order to maintain inert atmosphere and controlled vapor pressure. Therefore, this procedure is not suitable to growing CdTe and CdZnTe with a rotating seed.
In a typical growth the starting material is heated and transformed into a liquid, then homogenized for a period, then cooled somewhat below the melting point in order to solidify. The material is heated again in order to melt it except one end that will remain solid and will serve as a seed for the crystal growth.
The figure shows schematic presentation of the growth procedure in a multi-zone static furnace. A computer controls the temperature of each zone in order to generate a temperature profile. The profile moves upwards and the crystal grows in the boundary between two volumes. A lower volume of a temperature below the melting point and an upper volume of a temperature above the melting point. The upper end that contains vapors is adjusted to a lower temperature that determines the vapor pressure in the system.

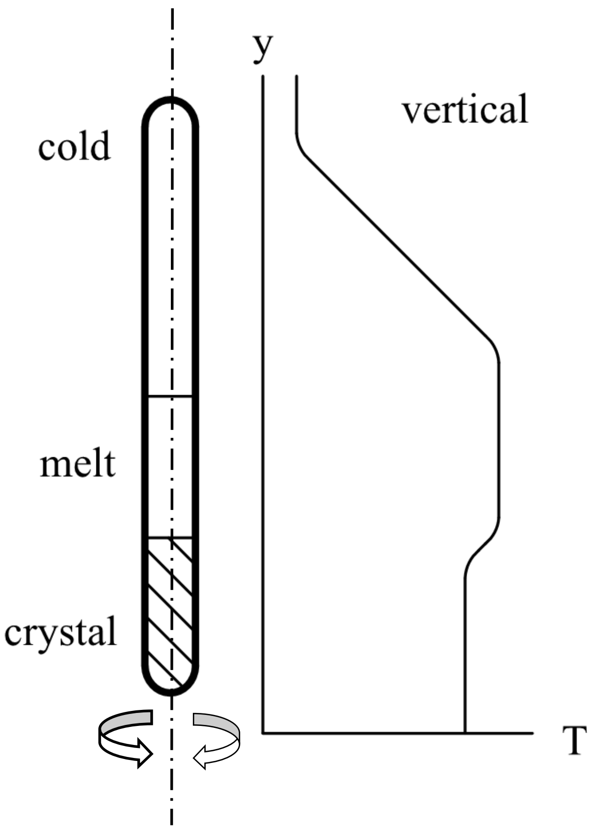

Figure: Bridgman crystal growth in an ampoule that agitates about its axis, in order to improve the crystal uniformity.

The seed cannot steadily rotate within the melt since they both are enclosed in one ampoule. Steady rotation of the ampoule as one unit will have only a marginal effect on the growth.
Agitating the ampoule, like in some models of washing machines, where the rotation switches directions forward and backward, will increase the relative rotating movement between the solid growing crystal and the liquid melt.
During agitation the ampoule rotation accelerates and deccelates, the rotation speed in one direction increases to a maximum and then decreases until it comes to a stop. Then the process is repeated the other direction, and the whole cycle is repeated. There is always relative movement between the solid growing crystal and the liquid, and the twisting forces within the melt homogenize it. Crystals that grow by this process are proposed to have better uniformity and better other properties

On the net: 29th Jun 2017

by the author:

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