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Gap Formation into Bulk InSb Crystals Grown by the VDS Technique Revealing Enhancement in the Transport Properties

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Abstract : The vertical directional solidification (VDS) technique has been applied to the growth of bulk InSb crystals. The concept of practical stability is applied to the case of detached bulk crystal growth on earth in a simplified design. By optimization of the set up and growth parameters, 32 ingots of 65-75 mm in length and 10-22 mm in diameter have been grown. The results indicate that the wetting angle of the melt on the ampoule wall and the pressure difference across the interface are the crucial factors effecting the meniscus shape and stability. Taking into account both heat transfer and capillarity, it is demonstrated that the process is stable in case of convex menisci (seen from melt), provided that pressure fluctuations remain in a stable range. During the crystal growth process, it is necessary to keep a relationship between the rate of the difference pressure controls and the solidification to maintain the width of gas gap. It is concluded that practical stability gives valuable knowledge of the dynamics and could be usefully applied to other crystal growth processes, especially those involving capillary shaping. Optoelectronic properties were investigated in relation to the type of solidification attached and detached ingots growth. These samples, room temperature physical properties such as Hall mobility, FTIR, Raman spectroscopy and microhardness achieved for antimonide samples grown by VDS technique have shown the highest values gained till at this time. These results reveal that these crystals can be used to produce InSb with high mobility for device applications.

Keywords : alloys, electronic materials, semiconductors, crystal growth, solidification, etching, optical microscopy, crystal structure, defects, Hall effect
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