The Effect of Transverse Magnetic field on Macrosegregation in vertical Bridgman Crystal Growth of Te doped InSb

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Abstract

An investigation of the effects of transverse magnetic field and Peltier effect on melt convection and macrosegregation in vertical Bridgman crystal growth of Te doped InSb was been carried out by means of microstructure observation, Hall measurement, electrical resistivity measurement and X-ray analysis. Before the experiments, Interface stability, convective instability and suppression of convection by magnetic field were calculated theoretically.

After doping 10^{18}, 10^{19} cm^{-3} Te in InSb, the temperature of Bridgman furnace was set up at 650℃. The samples were grown in I.D. 11mm, 100mm high quartz tube. The velocity of growth was about 2㎛/sec. In order to obtain the suppression of convection by magnetic field in the middle of growth, 2 - 4KG magnetic field was set on the melt. For searching of the shape of solid - liquid interface and the actual velocity of crystal growth, let 2A current flow from solid to liquid for 1second every 50seconds repeatedly (Peltier effect).

The grown InSb was polycrystal, and each grain was very sharp. There was no much difference between the sample with and without magnetic field at a point of view of microstructure. For the sample with Peltier effect, the Peltier marks(striation) were observed regularly as expected. Through these marks, it was found that the solid - liquid interface was flat and the actual growth velocity was about 1 - 2㎛/sec.

On the ground of theoretical calculation, there is thermosolutal convection in the Te doped InSb melt without magnetic field in this growth condition. and if there is more than 1KG magnetic field, the convection is suppressed. Through this experiments, the effective distribution coefficients, k_{eff}, were 0.35 in the case of no magnetic field, and 0.45 when the magnetic field is 2KG, 0.7 at 4KG. It was found that the more magnetic field was applied, the more convection was suppressed. But there was some difference between the theoretical calculation and the experiment, the cause of the difference was thought due to the use of some approximated values in theoretical calculation.

In addition to these results, the sample with Peltier effect showed unexpected result about the Te distribution in InSb. It looked like no convection and no macrosegregation. It was thought that the unexpected behavior was due to Peltier mark. that is, when the strong current flew the growing sample, the mark was formed by catching Te. As a result of the phenomena, the more Te containing thin layer was made. The layer ruled the Hall measurement.

The values of resistivity and mobility of these samples were just a little than those of other reference. It was thought that the reason of this result was that these samples were due to polycrystal, that is, grain boundaries had an influence on this result.